A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

APRIL, 1937.

GENERAL PHYSICS.

ADSORPTION.

1397. Adsorption of Carbon Monoxide on Zinc Oxide. W. E. Garner and J. Maggs. *Faraday Soc., Trans.* **32.** *pp.* 1744–1748, *Dec.*, 1936.—The heats of adsorption of CO on ZnO are determined from the adsorption isotherms over the range of temperatures 195–318° K. and are found to be in agreement with the results obtained in the thermocouple calorimeter. The adsorption isobar shows no discontinuity and the conclusion is reached that the discontinuities are met with only in the case of adsorbents where capillary flow is present. AUTHORS.

1398. Sorption of Water and Alcohol Vapours by Cellulose. J. K. Russell, O. Maass and W. B. Campbell. *Canad. J. of Research,* **15.** *Sect. B. pp.* 13–37, *Jan.*, 1937.—The amount of water vapour sorbed by beaten and unbeaten samples of kraft, unbleached sulphite and bleached sulphite wood pulps at relative vapour pressures ranging from 0 to 100 % was determined, and the results indicated that beating caused no change in the hydration of the cellulose. After previous wetting with water and drying, values were obtained for the sorption of methyl alcohol vapour by bleached sulphite, kraft and groundwood, and of sorption of propyl alcohol vapour by bleached sulphite and cotton. The alcohol was not entirely removed by subsequent evacuation at room-temperatures. Bleached sulphite and cotton, dehydrated by washing with propyl alcohol, gave less residual alcohol after evacuation and the shape of the curve differed from the above. Cotton dried over P_2O_5 *in vacuo* for a long period, held 0·35 % of water by weight, which was removable by heating at 100° C., and regained from the pentoxide on cooling. The hypothesis is enunciated that the crystalline submicroscopic elements of the cellulose structure are drawn together by internal tensile forces during the evaporation of the sorbed liquid, the bonding possibly taking place by the growing together of the crystal elements, leaving the internal structure stressed. On absorption, dissolution of the bonds occurs and the stresses are relieved.
S. G. B.

1399. Hysteresis in Water Sorption by Papermaking Materials. C. O. Seborg. *Indust. and Engin. Chem.* **29.** *pp.* 169–172, *Feb.*, 1937.—The hysteresis constant is believed to be connected with some molecular characteristic of the cellulose molecule associated with the mechanism of sorption. The theory based on the difference in number of OH groups available for attachment of water molecules during adsorption and desorption appears to be inadequate. A full explanation should include an additional factor of a physical nature. J. K.

1400. Disperse Wetting. I. R. Kljatschko. *Kolloid Zeits.* **78.** *pp.* 171–184, *Feb.*, 1937.—It is shown that measurements of disperse hysteretic wetting can be used for settling conditions under which flotation may be expected to take place. The technique of measurement previously described [see Abstract 927 (1936)] had for this purpose to be somewhat refined. The connected question of the washing away of adsorbed layers from ground and powdered minerals was investigated. It was found that the speed of washing can be used for the study of chemical reactions in surface layers. A notation for use in the discussion of the subject is put forward. P. H. B.

1401. Heats of Wetting of Activated Charcoal and Silica. J. L. Culbertson and L. L. Winter. *Am. Chem. Soc., J.* 59. *pp.* 308–310, *Feb.*, 1937.—The heats of wetting of charcoal and silica gel by water, nitrobenzene, benzene, CCl_4, CS_2 and petroleum ether have been determined. A correlation is noted between the order in which these values fall and that of the apparent densities of the solids as determined in the same liquids. AUTHORS.

See also Abstracts 1476, 1547, 1552, 1553, 1647, 1648, 1736, 1737, 1802.

ATOMIC AND MOLECULAR STRUCTURE.

1402. Atomic Physics. N. Feather. *Phys. Soc., Reports,* 3. *pp.* 66–88, 1936.—Progress review.

1403. Theory of the Lightest Nuclei. H. Dolch. *Zeits. f. Physik,* 104. 5–6. *p.* 478, 1937.—The author points out an error in one of his earlier papers [see Abstract 2928 (1936)] and notes that the agreement between theory and experiment which was there recorded, does not, in fact, exist. J. E. R. C.

1404. Approximately Relativistic Equations for Nuclear Particles. G. Breit. *Phys. Rev.* 51. *pp.* 248–262, *Feb.* 15, 1937.—The velocities (v) of neutrons and protons in the nucleus are small as compared with the velocity of light (c), and therefore relativity effects, which depend on v/c, need only be approximately considered. It is shown how the usual expressions for the interaction can be modified in such a way as to satisfy the requirements of relativistic invariance, neglecting powers of v/c higher than the second. The new terms which have to be introduced for this purpose bear the same relation to the ordinary forces as the magnetic terms to the electrostatic force in the interaction between electrons. Like the magnetic forces, they are responsible for the splitting of multiplet levels. The expressions are, however, more general than the analogy with magnetic forces would suggest and a number of different possibilities are discussed. R. P.

1405. Kinetic Energy of Nuclei in the Hartree Model. H. A. Bethe and M. E. Rose. *Phys. Rev.* 51. *pp.* 283–285, *Feb.* 15, 1937.—In the present note the question of the separation of the kinetic energy of the centre of gravity from the total kinetic energy of the nucleus is considered. This separation is necessitated in the calculation of nuclear energy levels by the use of the Hartree method. It is found that under certain conditions the wave function for the whole nucleus in absolute coordinates can be replaced by a product of the same function of the coordinates of the particles relative to the centre of gravity and a 1*s* wave function for the centre of gravity. These conditions are that oscillator wave functions be used for the individual particles and that the nucleus contain only one partly filled shell in both protons and neutrons with all shells of lower energy quantum number filled. It then follows that the kinetic energy of the nucleus is equal to the value calculated in absolute coordinates minus the energy of a single 1*s* particle. AUTHORS.

1406. Emergence of Low-Energy Protons from Nuclei. E. Pollard. *Phys. Rev.* 51. *pp.* 290–291, *Feb.* 15, 1937.—In bombarding Al, P, Cl, and Ca with α-particles, strong proton groups with a maximum range of about 20 cm. are found and they certainly extend down to ranges as low as 10 cm. This is surprising because for such slow protons the potential barrier of these nuclei should present a considerable difficulty in escaping. The fact then shows that the life-time of the nucleus, before it re-emits the α-particle, must be very long, of the order of 10^{-20} sec. or longer, in accord with Bohr's ideas of nuclear reactions. R. P.

1407. Angular Distribution of the Products of Disintegration of Light Elements by Hydrogen Ions. Part I. H. Neuert. *Phys. Zeits.* **38.** *pp.* **122–126,** *Feb.* **15, 1937.**—The angular distribution of the products of the disintegration of light nuclei by H-ion bombardment is examined with a cloud chamber. Deuteron containing substances under deuteron bombardment at energies of about 130 kV and B^{11} under bombardment by protons of 200 kV energy emitted protons and α-particles respectively with maximum intensities at angles of 0° and 180° and a minimum at 90°. On the other hand, between 40° and 140°, the protons formed on bombardment of Li^6 with deuterons of 180 kV energy were distributed isotropically.
F. C. C.

1408. Formation of Radio-Aluminium (Al^{28}) and the Resonance Effect of Mg^{25}. W. Y. Chang and A. Szalay. *Roy. Soc., Proc.* **159***A.* *pp.* **72–82,** *March* **2, 1937.**—The formation of radio-aluminium (Al^{28}) from Mg^{25} by the bombardment of α-particles is studied for different energies of the bombarding particles. Both thin targets (0·25 cm. stopping power) and thick targets are used. The resonance levels found are closely similar to those found for Mg^{24} by the direct observation of the proton emission. The present work, together with Waring and Chang's [see Abstract 11 (1937)], definitely shows that the resonance effect is closely connected with the emitted particle. By using Waring and Chang's hypothesis of the association of resonance effect with the emitted particle, it is suggested that the potential barrier of a nucleus does not exhibit any resonance levels and that the maxima in the yield of protons or neutrons are merely due to the pronounced changes in the probability of the " transition " giving rise to these particular particles.
AUTHORS.

1409. Reported Radioactivity of A^{38}. D. Roaf. *Roy. Soc., Proc.* **159***A. pp.* **133–138,** *March* **2, 1937.**—The alleged production of radioactive A^{38} by bombarding Cl with neutrons : $Cl^{37} + n_0^1 \rightarrow Cl^{38} \xrightarrow{\beta} A^{38}$, the A^{38} then giving off an α-particle, was examined by means of a specially designed Wilson chamber sensitive for 0·5 sec. No trace of any such radioactivity was found, and the sensitiveness of the method was such that if any of the A^{38} atoms thus formed were radioactive the fraction was $< 0{\cdot}053$ %.
C. A. S.

1410. Velocity Selector for Slow Neutrons. E. Segrè. *Accad. Lincei, Atti,* **24.** *pp.* **282–286,** *Nov.* **1, 1936.**—The theory of the velocity selector for slow neutrons [see Abstract 3923 (1936)] is developed and improvements are suggested. F. C. C.

1411. Scattering of Photo-Neutrons by Protons. A. Leipunsky, L. Rosenkewitsch and D. Timoshuk. *Phys. Zeits. d. Sowjetunion,* **10.** **5.** *pp.* **625–633, 1936.** *In English.*—The scattering in paraffin of neutrons, obtained from the photodisintegration of Be and D by γ-rays from Ra and its products, is studied. The mean free path is found to be 1·5 ± 0·4 cm. for photo-neutrons from Be and slightly more than 1 cm. for neutrons from D. It is shown that these results are in agreement with the Fermi-Wigner theory, provided that the mean free path of neutrons of thermal velocities in paraffin chiefly depends on the scattering by bound protons. AUTHORS.

1412. Scattering and Absorption of Photo-Neutrons from Beryllium. A. Leipunsky, L. Rosenkewitsch and D. Timoshuk, *Phys. Zeits. d. Sowjetunion*, 10. 6. *pp.* 751–772, 1936. *In English.*—The properties of photo-neutrons from a Be source are investigated. The cross-sections for the elastic scattering and the upper limits for absorption of photo-neutrons by different elements are measured. The possibility of inelastic collisons of these neutrons is discussed. AUTHORS.

1413. Energies of Selective Absorption Bands of Neutrons in Silver. N. P. Borisov. *Phys. Zeits. d. Sowjetunion*, 10. 6. *pp.* 711–717, 1936. *In English.*—By absorption of neutrons of groups C, A and B in boron it is found that (1) assuming the neutrons of group C to possess thermal energy ($2kT$), the energy of neutrons of group A, which are selectively absorbed in silver, is 2·4 eV; (2) the neutrons of group B have energies of about 117 eV. AUTHOR.

1414. γ-Rays Excited by Capture of Neutrons. J. H. E. Griffiths and L. Szilard. *Nature*, 139. *p.* 323–324, *Feb.* 20, 1937.—A method is described by the authors for observing the capture radiation emitted by slow neutron absorbers. Using the capture radiation of Cd as an indicator of the neutron intensity, the absorbing cross-section for slow neutrons is determined for a number of elements. The effect on the Geiger counter of the capture radiation from the 11 strongest slow neutron absorbers is observed. Though the atomic weight of these elements varies from 35 to 200, the effect per captured neutron is about the same for all of them. The number of quanta emitted per captured neutron is estimated for Cd.

1415. Simple Electronic Periodic Table. C. H. D. Clark. *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 281–292, *Jan.*, 1937.—A modern periodic table of the elements is presented, designed to give the electron configurations of atoms, excluding those of the rare earths, in their ground states by means of their positions in the table. It is shown that the electrons may be conveniently divided into antepenultimate **A**, penultimate **B**, and ultimate **C** groups of electrons, when it is found that the nature and number of electrons in these groups determine, in various ways, the periods and groups of the older table. Ten chemical propositions are stated, an attempt being made to interpret each of them in terms of the assigned **A**, **B**, and **C** electron groups. Sidgwick's theories are extended on this basis. The requirements of atomic spectral theory are found to correspond very well to the demands of chemical properties as expressed in the periodic table, thus effecting correlation between two different branches of experimental and theoretical science. AUTHOR.

1416. Maximum Valency of Elements and Atomic Structure. B. Ormont. *Acta Physicochimica*, 6. 1. *pp.* 115–130, 1937. *In German.*—Continuing previous work [see Abstract 429 (1937)] considerations are advanced concerning the part played by the *s*-electrons in the formation of intermolecular compounds in the cases of liquid NH_3, solutions of NH_3 and crystalline ammines. The ammines can be classified according to the quantum characteristic of the valency electrons of the central atom, the groups having different distribution and character of linking within the sphere of coordination. The possibilities of interaction between the coordinated ammonia molecules is determined by their number and the magnitude of the maximum coordination number. Results of investigations by different workers upon the band spectra and Raman spectra of NH_3, solutions of NH_3, solutions of ammonium salts in liquid NH_3, etc., are in harmony with the views put forward. Results of experimental determinations of the Raman frequency of $N-H$ are recorded for $Ag(NH_3)_2Cl$ in aqueous solutions and for NH_4NO_3 and NH_4CNS dissolved in liquid NH_3. L. A. W.

1417. Structure of Aqueous Solutions of Electrolytes. V. I. Danilow and W. E. Neumark. *Phys. Zeits. d. Sowjetunion,* 10. 5. *pp.* 673–685, 1936. *In German.*—The X-ray diffraction patterns given by aqueous solutions of LiCl, NaCl, LiOH and NaOH at room-temperature and at lower temperatures were photographed. From the microphotometer curves it is deduced that the ions H^+ and OH^- modify the proper structure of the water less than other ions and this is attributed to their high mobilities. At low temperatures approaching the crystallisation point in the systems NaCl-H_2O and LiCl-H_2O, the diffraction pattern obtained is that characteristic of pure water. To explain this it is suggested that inhomogeneities of concentration appear, and that the regions of reduced content of NaCl molecules give the diffraction pattern of pure water. W. S. S.

1418. Structures of Pure Inorganic Acids. F. L. E. Shibata. *Hirosima Journ. Sci.* 7. *pp.* 87–89, *Jan.*, 1937. *In German.*—Based on contrapolarisation theory and on Raman spectra, the author concludes that the molecular formulæ of 100 % inorganic acids containing O_2 are entirely different from those of the aqueous acids and possess the new structural group, OHO. H. H. Ho.

1419. Molecular Structure of Sulphuric Acid. F. L. E. Shibata and F. Murata. *Hirosima Journ. Sci.* 7. *pp.* 91–102, *Jan,* 1937. *In German.*—The molecular formula of 100 % H_2SO_4 has been investigated by numerous methods including those of Raman spectra, and the classical formula H_2SO_4 found not to be valid either for aqueous solutions or for the 100 % state. For the former, $(H\cdot aq)_2{}^+SO_4$ holds, while for the latter condition units of $S(OHO)_2$ represent the experimental data. By means of the viscosity and density curves for concentrated acids as well as for the 100 % acid, the formula $[\{[S(OHO)_2]_2\}_5]_{30}$ appeared to exist.

H. H. Ho.

1420. Structure and Molecular Forces in Pure Liquids and Solutions. *Faraday Soc., Trans.* 33. *pp.* 1–282, *Jan.*, 1937.—A general Discussion of the subject comprising 33 papers and preceded by an introductory contribution, etc.

"Pure Liquids and Liquid Mixtures," by **J. Kendall** (*pp.* 2–8).—Surprising results were reported on the effect of ethyl alcohol on the solubility of ethyl acetate in water.

PART I. PURE LIQUIDS.

"General Theory of Molecular Forces," by **F. London** (*pp.* 8–26).—Orientation Effect; Induction Effect; Criticism of the Static Models for Molecular Forces; Dispersion Effect, a Simplified Model; Dispersion Effect, General Formula; Additivity of the Dispersion Effect; Simplified Formula with some Numerical Values; Systematics of the Long Range Forces; Limits of Validity; Higher Approximations, Repulsive Forces; Experimental Test.

"Attempt at a Molecular Theory of Liquid Structure," by **J. D. Bernal** (*pp.* 27–45).—Starting from the assumption that the molecular structure of a simple liquid is one which is coherent and homogeneous, the author shows that it can always be represented statistically by a distribution function determined by 3 variables only; further, that the actual configuration of a particular liquid can be derived from a knowledge of the intermolecular potential function alone; also, a general classification of simple and complex liquids is proposed.

"Dependence on Temperature of the Specific Heat (C_v) of Monatomic Liquids," by **E. Bartholomé and A. Eucken** (*pp.* 45–54).—From older theories of the C_v values of monatomic liquids, it follows that the motion at low temperatures is similar to the vibration of a solid body, while at high temperatures it changes into free translation. A potential investigated by Teller and Pöschl fits these assumptions and the C_v curves for this potential are calculated. For all liquids it is necessary, in addition, to take account of association.

"Thermal Agitation in Liquids," by **L. Brillouin** (*pp.* 54–57).—The author compares a sort of ideal liquid with actual liquids.

"Liquid State and the Theory of Fusion," by **J. Frenkel** (*pp.* 58–65).—Heat Motion in a Liquid and Connection between Fluidity and Rigidity; Regularity of Structure and its Dependence on the Volume; Theory of Fusion and Crystallisation.

"Range of Stability of the Fluid State," by **F. Simon** (*pp.* 65–73).—Special reference is made to the continuation of the melting curve to high temperatures. It is shown that along the melting curve the entropy of the solid and liquid phases approaches an intermediate value, which indicates a growing similarity between the phases with rising melting temperature.

"Partition Function for Liquids," by **R. F. Newton and H. Eyring** (*pp.* 73–78).—A function is given which involves the coefficient of expansion and the specific heats, and leads to reasonable results for vapour pressures of most of the liquids examined.

"Reduced Temperature and General Properties of Pure Liquids," by **E. Bauer, M. Magat and M. Surdin** (*pp.* 81–86).—An equation of state for liquids is indicated where the triple point temperature is a constant of the same importance as the constants of van der Waals.

"Viscosity of Pure Liquids," by **A. G. Ward** (*pp.* 88–97).—It is concluded that no structural change with temperature of a type involving either an alteration in coordination or a change in the kind of force present, occurs in liquids obeying the exponential formula for the relation between viscosity and temperature, and that there is a close resemblance between the configurational charges involved in melting and viscosity.

"Intermolecular Forces of Normal Liquids," by **L. J. Hudleston** (*pp.* 97–103).—Here a law relating the force between molecules to the distance separating them is postulated and it is shown that the compressibilities of normal liquids at high pressures appear to confirm it. On certain probable postulates as to the statistical consequences in an assemblage of molecules a general relation is deduced between a term which should be proportional to the absolute temperature and another which should be proportional to the thermal expansion, and is found to fit the experimental data with great accuracy.

"Determination of Structure in Liquids," by **J. T. Randall** (*pp.* 105–109).—Reviews the present position.

"Identity of Structure in Liquid Lead and Bismuth," by **J. T. Randall and H. P. Rooksby** (*pp.* 109–110).—This paper gives an account of X-ray diffraction measurements on liquid lead and bismuth.

"Some New Results and General Interpretation of Diffraction by Amorphous Substances," by **J. A. Prins** (*pp.* 110–112).—X-ray reflection photographs have been obtained from free surfaces for some molten substances.

"Raman Spectra and the Constitution of Liquids," by **M. Magat** (*pp.* 114–120).—The quasi-crystalline hypothesis is favoured unambiguously for the structure of liquids. The Raman effect indicates that liquids, as well as solids, may possess points (or more correctly intervals) of transformation bound up with the appearance of free rotation.

"Structure of Liquids Studied in the Infra-Red," by **J. Errera** (*pp.* 120–129).—Data are discussed for dichlorobenzene, dibromobenzene, methyl, ethyl, and *iso*-amyl alcohols, glycerin, nitrobenzene and acetone, and for various mixtures of them.

"Diffusion and Absorption of Ultrasonics in Liquids," by **R. Lucas and P. Biquard** (*pp.* 130–135).—It is found that the diffusion of elastic waves by liquids can only be explained by the presence of elements of volume having a compressibility very different from the mean compressibility in the liquid under consideration.

"Absorption of Ultrasonic Waves in Liquids," by **J. Claeys, J. Errera and H. Sack** (*pp.* 136–143).—Here experimental details are given owing to discrepancies between the values calculated by the classical theory and the observed ones.

PART II. SOLUTIONS.

"Intermolecular Forces in Solutions, by **J. H. Hildebrand** (*pp.* 144–151).—This introductory paper surveys the effect of the intermolecular forces in solutions of two non-polar substances in the light of the evidence now available.

"Theoretical Basis of Raoult's Law," by **E. A. Guggenheim** (*pp.* 151–159).

"Change of Volume on Mixing and the Equations for Non-Electrolyte Mixtures," by **G. Scatchard** (*pp.* 160–166).—The volume change is expressed as the product of the compressibility and the excess of free energy over that of the corresponding ideal solution.

"Laws of Solubility," by **M. G. Evans** (*pp.* 166–170).—From a consideration of solubility curves it is shown that the entropy of solution is proportional to the heat of solution.

"Activities of Some Aliphatic Alcohols and Halides in Non-Polar Solvents," by **J. A. V. Butler and P. Harrower** (*pp.* 171–178).—This contains a discussion of measurements of partial pressures.

"Association, Heat of Mixing and Miscibility Gaps," by **K. L. Wolf** (*pp.* 179–190).—Emphasis is laid on the counterplay of shape and force in the phenomena of mixture and separation of molecules, atomic aggregations and inner structure, which governs the action of main or residual valency.

"Dipole Interaction in Mixtures of Benzene with Some of its Polar Derivatives," by **A. R. Martin** (*pp.* 191–200).—It is shown that dipole interaction suffices to account for the strong association of the hydroxylic compounds. Where the dipole is well shielded or very small, it is necessary to take into account dispersion forces as well.

"Structure of Some Molecular Complexes in the Liquid Phase," by **S. Glasstone** (*pp.* 200–214).—The paper contains a long discussion on the nature of association in liquids and the bonding forces of complex molecules.

"Dipole Solvation," by **W. H. Banks** (*pp.* 215–224).

"Complex Formation," by **G. Glockler** (*pp.* 224–229).—Rare gas hydrates, hydrocarbon hydrates, quasi-molecules, coloured molecular compounds, liquids and large organic molecules are now given a new classification in which the energy is the main consideration of stability.

"Energy and Entropy of Hydration of Organic Compounds," by **J. A. V. Butler** (*pp.* 229–236).—The entropies of hydration of non-polar molecules are found to vary roughly linearly with the heats of hydration. A linear relation which does not coincide with this is also found for the aliphatic alcohols.

"Effect of Ionic Forces Shown by the Liquid Structure of Alkali Halides and Their Aqueous Solutions," by **G. W. Stewart** (*pp.* 238–247). —There appears to be a carry-over from solid to liquid of some structural effect produced by crystal forming forces, and both the melting point and boiling point depend directly and indirectly upon the forces which are responsible for the crystalline and liquid states. This makes reasonable also characteristic structural differences in the liquid state.

"Electrical Forces between Ions and Neutral Molecules in Aqueous Solution. A Study of the Salting-Out Effect," by **P. S. Albright and J. W. Williams** (*pp.* 247–255).

"Refractometric Curves and State of Dissolved Strong Electrolytes," by **A. E. Brodsky** (*pp.* 256–268).—Here the author shows that there are no sufficient grounds as yet for rejecting the Sutherland-Bjerrum hypothesis.

"Diamagnetism of Salts in Aqueous Solutions," by **G. W. Brindley and F. E. Hoare** (*pp.* 268–273).—The whole discussion is summarised by **J. A. V. Butler.** H. H. Ho.

1421. Structure of Liquid Hydrogen Peroxide. J. T. Randall. *Roy. Soc., Proc.* 159*A. pp.* 83–92, *March* 2, 1937.—An X-ray investigation of the structure of liquid H_2O_2 has been carried out, using a modified form of the Debye-Menke Fourier analysis method. This method enables not only the interatomic positions to be determined, but also the number of neighbours of any given atom or ion. The structure of liquid H_2O_2 is essentially that of cubic close-packing and the radial distribution curve fixes the types as face-centred. This determination has been used to fix the directions of the OH bonds and it is found that the Penney-Sutherland model is the most probable one. The angles θ, ϕ, of the skew model are determined as $\pi/2$ rather than 100° and this gives a dipole moment of $2 \cdot 23 \times 10^{-18}$ e.s.u. compared with the experimental value of $2 \cdot 13 \times 10^{-18}$ e.s.u. AUTHOR.

1422. Molecular Structure of Inorganic Fluorides. H. Braune and P. Pinnow. *Zeits. f. phys. Chem.* 35. *Abt.B.* 4. *pp.* 239–255, 1937.—In contradistinction to results obtained with hexafluorides of the S group of elements [see Abstract 3210 (1933)], it is found by electron diffraction methods that the hexafluorides of U, W and probably Mo do not possess regular-octahedral structures. The results are best interpreted in terms of the structures being assumed to possess rhombic symmetry. SiF_4 possesses a tetrahedral structure. Results with PF_5 indicate that it possesses an (unspecified) symmetrical structure. In the case of IF_5 it is found that all I–F interatomic distances are equal. BF_3 possessses a plane configuration. The ionic radius of pentavalent I (I^{5+}) is found to be, by calculation, 1·46 Å, a value which is intermediate between that of I^-, (2·16 Å), and that of I^{7+} (0·50 Å). J. S. G. T.

1423. Electronic Structure of Methane. C. A. Coulson. *Faraday Soc., Trans.* 33. *pp.* 388–398, *March*, 1937.—The method of molecular orbitals is applied to a preliminary study of the ground state and some excited levels of CH_4. With a suitable scheme of effective nuclear charges (0·9*e* on each H nucleus and 1·72*e* on the C nucleus) the correct binding energy is obtained, and these values give quite fair agreement with those critical potentials that have been determined. A discussion is given of the polarity of the orbitals, and explicit forms are obtained for the wave-functions of the various orbitals. AUTHOR.

*1424. **Molecular Properties of Lignin Solutions. D. L. Loughborough and A. J. Stamm.** *J. Phys. Chem.* 40. *pp.* 1113–1132, *Dec.*, 1936.—Lignin from maple and spruce wood, isolated by three different methods and dissolved in a number of organic solvents, gives molecular weights of two magnitudes, *viz.*, 3900 ± 300 and 10,000 ± 1000. The former value, considered the more correct, was derived from osmotic pressure and boiling-point elevation and the latter from diffusion experiments. The origin of the difference lies not in polymerisation but in the non-spherical shape of the molecule. The shape-factor indicated by the Einstein constant derived from viscosity determinations is of the order 6 to 8 and, if allowance is made for this in computing molecular weight from diffusion data, the higher estimate for molecular weight is ruled out. Spreading measurements, assuming the figure 3900 ± 300, give a possible molecular size of 3 × 16 × 100 Å. L. V. C.

1425. Seventh Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, O. Hönigschmid and P. LeBeau. *Am. Chem. Soc., J.* 59. *pp.* 219–226, *Feb.*, 1937.—The changes proposed [see Abstract 2488 (1936)] are C from 12·00 to 12·01, Rb from 85·44 to 85·48, Gd from 157·3 to 156·9, Pb from 207·22 to 207·21 and U from 238·14 to 238·07. Results discussed, but not held to justify action, deal with the supposed difference in isotopic constitution of O in air and water; and the abundance ratio K^{39}/K^{41} [see Abstracts 1923 and 1402 (1936)]; also regarding the atomic weight of Ga tending to change this to 69·74; of Ge to 72·59; Mo to 95·95; and of W to 183·92. Redeterminations confirm the atomic weights of Ag, Cd, and Ta. New measurements of doublets by Aston give (O^{16} = 16·0) H 1·00812, D 2·01471, He 4·00391, C^{13} 12·0035 with an abundance ratio of C^{13} = 1/100, and N^{14} 14·0073. C. A. S.

1426. Relative Atomic Weight of Oxygen from Air and Water. T. O. Jones and N. F. Hall. *Am. Chem. Soc., J.* 59. *pp.* 259–261, *Feb.*, 1937.—It has been found that the exchange equilibrium between water vapour and O_2 is rapidly established on a hot wire at 1800° Abs. and above, but much more slowly at lower temperatures. Water thus equilibrated with excess air increases in density by about 7 p. p. m., and the Dole effect is confirmed. Oxygen-abnormal water may be prepared conveniently by this method, and the oxygen isotope ratio of an unknown sample may be studied with its aid. AUTHORS.

1427. Molecular Induction. J. Perrin. *Acta Physica Polonica*, 5. *pp.* 319–332; *Disc.* 332–334, 1936. *In French.*—It is considered that molecular energies may be changed by electromagnetic induction (apart from collisions as envisaged by the kinetic theory) a resonance effect being postulated. The implications of this as regards absorption, fluorescence, phosphorescence, etc., are considered at length. A. H.

See also Abstracts 1456, 1462, 1463, 1480, 1525, 1530, 1596, 1615, 1621, 1655, 1666, 1667, 1673, 1683, 1691, 1693, 1694, 1707, 1733, 1754, 1797, 1828, 1829, 1830.

COLLOIDS.

1428. Numerical Fixation of the Lyotropic Series of Univalent Kations. A. Voet. *Kolloid Zeits.* 78. *pp.* 201–204, *Feb.*, 1937.—Previous work [see Abstract 17 (1933)] is now continued and a method is communicated which is based on flocculation experiments on lyophobic sols and enables the numerical fixation of the lyotropic series. H. H. Ho.

1429. Direct Examination of Sols by X-Ray Diffraction Methods. W. O. Milligan and H. B. Weiser. *J. Phys. Chem.* 40. *pp.* 1095–1102, *Dec.*, 1936.—A number of hydrosols are examined by X-ray diffraction methods, in a specially designed Debye-Scherrer camera which permits the direct examination of a completely unenclosed, flowing column of sol. Alumina sols prepared by the action of amalgamated alumina on water and by the peptisation of precipitated alumina give the pattern of $\gamma\ Al_2O_3H_2O$. Ferric oxide sols are found to consist of particles of $\alpha\ Fe_2O_3$ or $\beta\ FeOOH$ depending on the method of preparation. Stannic oxide sol (Zsigmondy), a protected Ag sol (Argyrol), an indium hydroxide sol, a negative silver iodide sol, and a titanium dioxide sol give respectively the patterns of SnO_2 (cassiterite), metallic Ag, $In(OH)_3$, AgI and TiO_2 (rutile). It is concluded that the common inorganic hydrosols consist in general of particles of simple oxides or hydrates, elements, or salts, and not of complexes as postulated by some investigators. C. J. B. C.

1430. Particle-Size Distribution in Colloidal Systems. E. A. Hauser and C. E. Reed. *J. Phys. Chem.* 40. *pp.* 1169–1182, *Dec.*, 1936.—A new method employing the supercentrifuge is described for making particle-size fractionations and measuring particle-size distribution curves of colloidal systems. The effects of particle size on thixotropy and gel structure in general are being investigated. J. K.

1431. Microscopic Determination of the Size of Aerosol Particles. B. Rotzeig and N. Fuchs. *Acta Physicochimica*, 5. 6. *pp.* 893–902, 1936. *In German.*—The size of the aerosol particles is measured in a Millikan condenser with a strong electric field, which causes the particles carrying known charges to oscillate up and down with a great enough velocity to make the disturbances due to the Brownian motion negligible. For oil and sal-ammoniac aerosols the limiting radius is approximately $0{\cdot}1\ \mu$. The method is independent of the apparent density of aggregate particles in the smoke. Through quick mixing of an air current, bearing vapour, with a cold current for either mineral oil or sal-ammoniac, submicroscopic particles are obtained. The particles in fine, freshly-made aerosols are usually evenly dispersed. H. M. B.

1432. Electrophoretic Mobility of Purified Tristearin. Part I. A. L. Roberts. *Faraday Soc., Trans.* 32. *pp.* 1705–1717, *Dec.*, 1936.—The electrophoretic mobility of purified tristearin in different buffer solutions has been examined as a function of pH between the pH values 2 and 7, and also the variation of this mobility with pH in NaCl and KCl solutions. The effect of different added anions has been determined at fixed pH values and the mobility is found to be chiefly a function of the salt concentrations rather than of the individual ions. The variation of mobility with pH in the absence of any electrolyte, except that necessary to attain the pH values, has been studied, and the effect of small amounts of CO_2 is found to be negligible. The electrokinetic charge density σ is found to increase with fall in pH in the " absence " of electrolytes but decreases with fall in pH if salt is present. Further, σ is found to increase with rising salt concentration at constant pH. To account for the variation in σ it is necessary to assume either primary adsorption of the added anions, or exchange of H^+ ion in the rigid secondary layer by the added kations, thereby producing a less tightly bound system, and so increasing the effective electrokinetic charge. Under comparable concentration conditions, H^+ ion is much more strongly adsorbed into the rigid secondary layer than is any other kation, and the amount adsorbed is a function of the effective primary charge as well as of pH. H. H. Ho.

1433. Diffraction of Light by Colloidal Solutions. Part II. A. S. Menon. *Kolloid Zeits.* 78. *pp.* 185–191, *Feb.*, 1937.—The degree of polarisation and the intensity of light diffracted by various copper-, copper hydroxide- and mercury sulphide sols are investigated. Copper sols contain spherical particles while copper hydroxide and mercury sulphide sols consist of non-spherical particles. The polarisation maximum of the diffracted light is for all these sols at right angles to the incident ray. The position of the polarisation maximum is the same for systems containing conducting particles (*e.g.*, copper) as for those having non-conducting particles (*e.g.*, copper hydroxide and mercury sulphide). Sols having particles less than 115 $\mu\mu$ dia. diffract light according to Rayleigh's equation. A sol with 133 $\mu\mu$ particle size shows anomalous light diffraction. [For Part I see Abstract 4460 (1936)]. The paper is followed by two observations on the work of the author by **M. Katalinić** (*ibid.*, pp. 191–193). J. K.

1434. Viscosity Caused by Colloidal Particles and Large Molecules. J. W. McBain and M. E. L. McBain. *Am. Chem. Soc., J.* 59. *pp.* 342–344. *Feb.*, 1937.—From observations on the actual effect on resistance to movement when a sphere is elongated to a fibre 2500 times longer than its diameter, it is concluded in accordance with the hydrodynamic theory employed by Einstein for colloidal particles and large molecules that although the effect of extreme departure from sphericity is measurable it is of too low a magnitude to explain the high viscosity which 0·1 % of certain colloids, such as nitrocotton, impart to solvents in which they are dissolved. It is therefore concluded that the chief factor is structural viscosity due to entanglement and local adherence of molecules and particles, effectively immobilising a disproportionate amount of the solvent in comparison with the amount of the colloid itself. AUTHORS.

1435. Rigidity of Gelatin. D. Teodorescu. *Soc. Roumaine Phys., Bull.* 37. 67. *pp.* 35–51, 1936.—The fraction method, using suitable apparatus, is adopted to study the variations of the rigidity modulus of gelatin with respect to the concentration at a given temperature. The variations between 9 % and 21 % concentration can be related empirically, while between 21 % and 40 % the variation is proportional to the square of the concentration. It is concluded that for any given temperature there is a concentration at which the gelatin changes its constitution from the " gelée " to the " gel " state. J. K.

1436. Swelling and Solvation of Rubber in Different Solvents. Ira Williams. *Indust. and Engin. Chem.* 29. *pp.* 172–174, *Feb.*, 1937.—It is shown that the fractional increase in viscosity on dissolving rubber in different solvents bears no relation to the viscosity of the solvents but is proportional to the swelling of the rubber in the solvents. The replacement of one solvent by another solvent in a rubber sol produces the viscosity characteristic of the second solvent, thus indicating an equilibrium between each solvent and the rubber. J. K.

1437. Hydrophilic Properties of Cellulose. Part IV. K. Kanamaru and T. Nakamura. *Kolloid Zeits.* 78. *pp.* 209–218, *Feb.*, 1937.—A continuation of the previous work [see Abstract 989 (1937)] this time using cellophane packing (non-hygroscopic) as medium. The paper constitutes a comparison of the behaviour when subjected to the action of thallium nitrate and tetra-chloride as compared with the previously noted $AlCl_3$. The Tl salts are used as before to neutralise the natural charge on the cellulose. The typical effects as enumerated previously are observed the hygroscopicity and ζ-potential exhibiting the typical phenomena. With increase of the concentration of the salt solution, *i.e.*, the decrease of the negative charge, the hygroscopicity of the cellulose decreases; when the concentration further increases and the charge becomes positive instead of negative, the hygroscopicity again increases. At yet higher concentrations another decline in hygroscopicity occurs, at the point where the free charge cannot be raised further on the positive side. Interesting results are appended on the action of titanium chloride which are not typical and a decrease in hygroscopicity is only noted to a certain limitation. No electrostatic adsorption of this substance with cellulose is found, as in the above cases. [See following Abstract.] S. G. B.

1438. Hydrophilic Properties of Cellulose. Part V. K. Kanamaru and Y. Fukuhara. *Kolloid Zeits.* 78. *pp.* 218–224, *Jan.*, 1937.—If an electropositive metallic oxide or hydroxide is finely distributed throughout an electronegative cellulose structure and absorbed electrostatically on the micellar surfaces, then the hydrophilic properties will be definitely affected when the definite quantity of the oxide is added to produce an electroneutral state. The present work recounts experimental work on the regeneration of electroneutral cellulose produced by the action of Al salts, and the effects on the spinning and fibres produced. Cellulose fibres of varying Al content were produced. In general, increase of Al content of the bath, *i.e.*, with decrease of the negative charge of the fibre coagulated therein, the hygroscopic capacity decreased, but at very high Al contents whilst the hygroscopic capacity declined a little no further increase in the free charge occurred. The breakdown of the fibre is symbolical of its charge and hygroscopic property. The regenerated cellulose from electroneutral viscose has the smallest extensibility and thickness. The elasticity of the fibre increases very quickly with increase of the Al content of the spinning bath up to the point where the fibre is discharged, and above this point it increases further but very slowly. The water absorption of electroneutral viscose is about the same as ordinary commercial cellophane, but its flexibility in sheet form is less. [See preceding Abstract.] S. G. B.

1439. Liesegang Rings. T. Okaya. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 72–87, *Jan.*, 1937. *In French.*—The case of a drop of solution of $AgNO_3$ on a sheet of gelatin impregnated with K_2CrO_4 is dealt with. A complex mathematical expression for the concentration of the Ag^+ ion at a given time and distance from the centre of the drop is arrived at, the result applying to the first few rings. C. A. S.

*1440. **X-Ray Structure and Morphology of Cellulose. E. Sauter.** *Zeits. f. phys. Chem.* 35. *Abt.B.* 2–3. *pp.*83–128, 1937.—A review of the X-ray analytical methods and apparatus for the investigation of fibre structure. With Cu radiation for raw cellulose in the vertical section fibre diagram 67 line reflections have been established, of which 25 are designated in the literature as interference and 42 are new. Measurements were made of the fibre diagram from both the crystal monochromatic and the X-ray goniometric points of view and resulted in new knowledge concerning the translation lattice of native cellulose and its characteristic symmetry. The elementary cell-model due to Mark and Meyer (1928) is thereby proved incorrect, whilst the earlier work of Doree and Sponsler (1926) on the dimensions of the elementary cells of raw cellulose is approximately correct. The new results are incorporated into a new elementary cell-model. There arises from the experimental results the point that in monochromatic crystal diagrams of cellulose fibres of different origin, if a sufficient illumination is used, there exists a more or less intensive line spectrum near the crystal grating spectrum, that gives a particularly high value for lattice disturbance which is characteristic of the fibre material. The ultra-crystalline fibrillar lattice diffraction reveals the macromolecular scheme for the building up of the cellulose fibre, and is contrary to the micellar structure in the sense of Meyer and Mark. These lattice behaviours, are of prime influence in determination of the physical characteristics of the cellulose fibres, and explain their heterogeneous manner of reaction and their mechanical working and swelling phenomena. S. G. B.

1441. **Concentrated Suspensions. H. Freundlich and A. D. Jones.** *J. Phys. Chem.* 40. *pp.* 1217–1236, *Dec.*, 1936.—The properties considered are those of sedimentation volume, dilatancy, thixotropy and plasticity. The properties of a large number of pastes made from finely powdered solid substances with water or a few aqueous solutions were investigated in order to test the rule that close packing is connected with a small volume of sedimentation and to dilatancy but not to thixotropy and plasticity, while loose packing is connected with a large volume of sedimentation, thixotropy and plasticity and not to dilatancy. The rule has been found to hold for a large number of cases. A number of limitations of the rule are given. J. K.

1442. **Ultrafiltration through Cellophane. J. W. McBain and R. F. Stuewer.** *J. Phys. Chem.* 40. *pp.* 1157–1168, *Dec.*, 1936.—Commercial sheet cellulose is much less porous than formerly. It is now necessary to swell in $ZnCl_2$ solutions exceeding 63 % $ZnCl_2$ (37 % water), in order to make these membranes freely permeable to all ordinary molecules. Further, the ionic concentration must be sufficient to suppress Donnan effects in the case of very dilute electrolytes, including colloids. Contrary to a previous intimation, owing to this change in a commercial membrane there remains no certain evidence for colloid in iodate solutions, although some is indicated in very concentrated aqueous CdI_2. With incompletely permeable membranes such as ordinary cellulose, interesting influences of size of molecule, concentration, rate of stirring, pressure, viscosity, and diffusion are observed. AUTHORS.

*1443. **Improvements in the Air-Driven Ultracentrifuge for Molecular Sedimentation. R. W. G. Wyckoff and J. B. Lagsdin.** *Rev. Sci. Instruments*, 8. *pp.* 74–77, *March*, 1937.—A description is given of the following improvements in an air-driven ultracentrifuge intended for molecular sedimentation: (1) A driving mechanism equipped (A) with reversing air jets that provide for smooth and rapid stopping and (B) with spring compression screws for adjustment to eliminate vibrations. (2) A head which makes it possible to centrifuge considerable volumes of solution in a field sufficiently great to concentrate and crystallise large protein molecules. (3) The use of a high-pressure mercury arc in place of the usual d.c. lamp as light source for both absorption and refractive index measurements. (4) A device for automatically taking the series of photographs needed for determinations of rate of sedimentation.

AUTHORS.

See also Abstracts 1398, 1424, 1495, 1529, 1802.

CRYSTAL STRUCTURE AND PROPERTIES.

1444. Properties of the Vibrational Spectrum of a Lattice. M. Blackman. *Cambridge Phil. Soc., Proc.* 33. *pp.* 94–103, *Jan.*, 1937.—The vibrations of particles constituting a crystal can be conditionally represented in terms of normal vibrations, and the density of these vibrations is known to vary as ν^2 when the frequency is very small. This mathematical paper presents an investigation of the small frequency region. A simple cubic lattice containing two types of particles and the region in and adjacent to which the crystal has the properties of an elastic continuum are considered. The variation of the θ_D value with temperature is examined, and for a Born-Kármán lattice it is shown that density increases faster than ν^2 in the adjoining region. N. M. B.

1445. Vibrational Spectrum of a Three-Dimensional Lattice. M. Blackman. *Roy. Soc., Proc.* 159*A*. *pp.* 416–431, *April* 1, 1937.—The vibrational spectrum of a simple cubic lattice of the Born-Kármán type is calculated in a particular case ($\gamma/\alpha = 0\cdot05$) by a numerical method. The features of this spectrum are checked by considering an extreme case ($\gamma = 0$, $\alpha \neq 0$) in which formulæ for the spectrum of each of the frequency branches are derived. General considerations on the form of the frequency surfaces in "phase" space are used to determine qualitatively the form of the spectrum for simple cubical lattices characterised by other values of the parameter γ/α. The results obtained are used in a discussion of the type of specific heat curves to be expected for these lattices. The applicability of the conclusions to actual crystals is considered. AUTHOR.

1446. Crystallisation of Halides of Hydrogen and the Alkalies. T. Neugebauer. *Zeits. f. phys. Chem.* 35. *Abt.B.* 2–3. *pp.* 129–138, 1937.—Chemically the halides of H and the alkalies are similar but the latter have a well-defined rock-salt lattice, while the former are diatomic gases at room-temperature and at low temperature have a lattice with van der Waals bonding. Cs halides crystallise in yet another lattice. From theoretical considerations it is shown that polarisation energy is responsible for these differences. This energy, set free in molecule formation, can be small only when the kation is a proton, otherwise it cannot compensate for electrostatic energy derived from lattice formation, on account of Fermi repulsion. Goldschmidt's atomic radii of 1·33, 1·81, 1·96, 2·19 Å for F, Cl, Br, I respectively, give values of 3·56, 4·87, 5·24, 5·86 for distance between electrons, and − 0·491, − 0·359, − 0·333, and − 0·298 for E_M, both expressed in Hartree atomic units. By detailed theoretical calculation, and evaluation of the integral of HCl, $\Sigma E = E_M + E_C + E_F$ is found to be a minimum for a distance of 4·82, in good agreement with the above value. By use of tables the final corrected value for dissociation energy is found to be 14·45eV, in good agreement with the observed value. Other hydrides with H as anion do crystallise in ionic lattices, on account of Fermi repulsion. Boundary line cases, H_2O, H_2S, H_2Se in molecular lattices, oxides and sulphides of Li and Na in ionic lattices, and condensible gases PH_3, AsH_3, SbH_3, CH_4, SiH_4, are discussed [see Abstract 25 (1936)]. D. R. H.

1447. Distortion of the Gold Lattice on Cold-Working. W. Boas. *Zeits. f. Krist.* 96. 2–3. *pp.* 214–224, 1937.—Au filings are soaked for 8 hr. in a CO_2 atmosphere, the temperature reaching 900° C., slowly cooled and cemented into a rod of 0·9 mm. dia. with dilute collodion. Exposures by the powder method are made at 50 kV and 5–6 mA for 15 min. with Cu K_β-radiation. filtered through 0·015 mm. Ni foil. Intensities and breadths of lines for the distorted and annealed filings are compared and do *not* correspond to chaotic displacement of all atoms from their equilibrium positions. By calculation, the energy absorbed is found to be 20–30 times that attributable to crystal deformation. From the relation $\sigma = 3\epsilon/H$ where $\epsilon = da/a$, the existence of an elastic tension of 26 kg./(mm.)^2 (16·7 tons/(in.)^2) is calculated to exist in Au filings, against previously determined values of 39 for Ni, 16 and 17 for single crystal Cu, 11, 28 and 39 for polycrystalline Cu. Experimental facts regarding broadening of lines are summarised, and the nature of lattice distortion is discussed. D. R. H.

1448. Methods of Establishing Existence of Polymorphism. A. L. T. Moesveld. *K. Akad. Amsterdam, Proc.* 40. 2. *pp.* 155–164, 1937. *Zeits. f. phys. Chem.* 178. *Abt. A.* 6. *pp.* 455–467, 1937.—Methods used in the study of allotropic phenomena are discussed. The conclusion that substances can exist in one single modification only may not be drawn from experiments based on those methods. The importance of the phenomena of retardation is pointed out for reconciling the existence of allotropic modifications and the smoothness of graphs of physical properties of a solid as a function of the temperature. The results are given of measurements of the electrical conductivity of tin between − 78° and + 99° C.; their importance in this connection is due to the fact that the values found can be represented by a smooth curve, although tin has a transition point at 13·2° C. AUTHOR.

1449. Ni-Al System. A. J. Bradley and A. Taylor. *Roy. Soc., Proc.* 159*A*. *pp.* 56–72, *March* 2, 1937.—From powder photographs of slowly cooled and quenched alloys an X-ray analysis is made of the Ni-Al system. The α- and α′- phases (face-centred cubic) are merged at high temperatures but below 1000° C. there is a miscibility gap. The α′-phase, which corresponds closely to the compound Ni_3Al, remains single-phased whether cooled slowly or quenched, but the spacing of the slowly cooled alloy exceeds that of the quenched alloy by 1 %. The reason for this is not due to differences in the state of order, but may be connected with the low Curie point (50° C.). Ni-Al is body-centred cubic and excess of either Ni or Al causes the spacing to become smaller. In the case of excess Ni the effect is straightforward but the effect in the case of excess Al is explained as being due to the subtraction of Ni atoms rather than to the addition of Al atoms. With decreasing Ni content the structure is deformed and becomes trigonal. This is the δ-phase Ni_2Al_3. There is, however, an intermediate narrow two-phase region. The ε-phase $NiAl_3$ is orthorhombic with 16 atoms per unit cell. The space group is C_{2h}^{16} (*Pnma*) and the cell dimensions are a = 6·5982 Å., b = 7·3515 Å. and c = 4·8021 Å. J. T.

1450. Structure of Compounds of the Rare Earths with the Metalloids of Group V. A. Iandelli and E. Botti. *Accad. Lincei, Atti,* 24. *pp.* 459–464, *Dec.* 6, 1936.—The method and difficulties of preparing the phosphides of La, Ce and Pr are described. The structures are studied by the X-ray powder method. All the lines on the photographs could be indexed by means of Hull's graphs for a face-centred cubic lattice, There are two possible structures, either a lattice of the zinc blende type or one of the NaCl type. As other phosphides are known to have a blende type of lattice, it is concluded that this is the most probable. The cell sides have dimensions $6 \cdot 01_3$, $5 \cdot 89$, and $5 \cdot 86$ Å for the La, Ce and Pr compounds respectively. Arguments in favour of a possible ionic structure of these phosphides are :—the characteristic lattice of ionic compounds, and the fact that if the size of the elementary cell is calculated from the atomic radii of the metals and of P the value is always lower than the experimental value. The value of the atomic radius of P^{3-} obtained from the experimental results is $1 \cdot 77$ Å compared with Pauling's theoretical value, $2 \cdot 12$. C. J. B. C.

1451. Dimorphism of White Phosphorus. G. Natta and L. Passerini. *Accad. Lincei, Atti,* 24. *pp.* 464–471, *Dec.* 6, 1936.—An accurate X-ray study of white P is made by the powder method at temperatures − 35°, − 55° and − 170° C. The work confirms the dimorphism of white P but does not permit the confirmation of the lattice dimensions previously proposed for a white P. The broad lines on the photographs are attributed to the strong thermal agitation of the molecules and not, as supposed by Young, to the transformation from white to red P under the photochemical action of X-rays. β-white P is different in that it shows a marked crystalline structure, giving sharp lines on the powder diagram. The low symmetry and large dimensions of the elementary cell do not permit the exact determination of the structure by the powder method. The probable dimensions are, $a = 8 \cdot 55$ Å, $c/a = 1 \cdot 60$. C. J. B. C.

1452. Electron Diffraction by Thin Crystalline Films. V. A. Kolpinsky. *Phys. Zeits. d. Sowjetunion,* 10. 4. *pp.* 484–494, 1936. *In English.*—Experiments are described of the diffraction of a beam of electrons, with a velocity of approximately 34 kV, from a film of NaCl. The patterns obtained are modifications of the Debye-Scherrer type of X-ray diffraction. An explanation of the diagrams is advanced and in addition the size of the crystals forming the film is calculated from the shape and distribution of the diffraction spots. J. I.

1453. Structure of Braggite and Palladium Sulphide. T. F. Gaskell. *Zeits. f. Krist.* 96. 2–3. *pp.* 203–213, 1937. *In English.*—Palladium, sulphide is tetragonal, space group $P4_2/m$, $a = 6 \cdot 43$, $c = 6 \cdot 63$ Å, 8 mol. in the unit cell. The structure was determined by direct Patterson and Fourier analysis on visually estimated intensities of reflections. The arrangement of the Pd atoms closely resembles the β-W structure. The S atoms lie almost at the corners of a cube of half the linear dimensions of the unit cell, and twisted a little about the central half-screw axis. The structure shows deformed tetrahedra of Pd about S atoms, and three types of deformed square in the arrangement of S about Pd atoms. This latter deformation in two cases retains the plane arrangement, but it is not square, in the third, retains the square arrangement but is not planar. AUTHOR.

1454. Discovery of Braggite. F. A. Bannister. *Zeits. f. Krist.* 96. 2–3. *pp.* 201–202, 1937. *In English.*—From the portion of the platiniferous norites from Rustenburg (Transvaal) insoluble in aqua regia the crystals of sperrylite and laurite were picked out by hand. X-ray examination of the remainder divided the grains into two classes: (A) Cooperite, PtS, tetragonal, with unit cell *a* 4·91, *c* 6·10 Å, and containing 8 molecules, space group D^9_{4h} (*P*4/*mmc*); and (B) Braggite, also tetragonal with *a* 6·37, *c* 6·58 Å, space group C^2_{4h} ($P4_2/m$), or C^2_4 ($P4_2$), and identical with those of artificial PdS which contains 8 molecules. The composition is (Pt, Pd, Ni)S, and approximately $Pt_8\ Pd_5\ Ni_3\ S_{16}$. C. A. S.

1455. Crystallography of Strontium Oxalate. H. A. Klasens, W. G. Perdok and P. Terpstra. *Zeits. f. Krist.* 96. 2–3. *pp.* 227–230, 1937. *In English.*—" Envelope " crystals of SrC_2O_4 were prepared by allowing a solution of $Sr(NO_3)_2$ containing HNO_3 to diffuse slowly into one of $H_2C_2O_4$. The crystals of composition SrC_2O_4, 2·5 H_2O are tetragonal, *d* 2·384, *a* : *c* = 1 : 0·580, ω 1·517, ϵ 1·535; X-rays show a unit cell with *a* 12·795, *c* 7·509 Å and containing 8 molecules. The cauliflower-like crystals obtained by Bruhns [*Zeits. f. anorg. allg. Chem.* 95. *p.* 210, 1916] contain $1H_2O$ and are monoclinic with *a* : *b* : *c* = 2·843 : 1 : 0·675, β 83 51′. The tetragonal form is $CaC_2O_4 \cdot 3H_2O$, *d* 2·122, *a* : *c* = 1 : 0·595; X-rays show its unit cell to have *a* 12·375, *c* 7·377 Å and to contain 8 molecules. Thus both the Sr and Ca salts occur in two forms, the monoclinic both containing $1H_2O$, but not isomorphous, and the tetragonal, which contain different amounts of H_2O but are isomorphous. C. A. S.

1456. Valency Angle of Bivalent Lead: Structure of the Ammonium, Rubidium, and Potassium Pentabromodiplumbites. H. M. Powell and H. S. Tasker. *Chem. Soc., J. pp.* 119–123, *Jan.*, 1937.—The three compounds have a tetragonal structure with unit cell dimensions as follows,

	$NH_4\ Pb_2\ Br_5$	$Rb\ Pb_2\ Br_5$	$K\ Pb_2\ Br_5$
a (Å)	8·39	8·41	8·14
c (Å)	14·34	14·5	14·1
No. of mol. per cell ...	4	4	4
Space group	I4/*mcm*	I4/*mcm*	I4/*mcm*

The detailed structure of the NH_4 and Rb compounds is worked out on the basis of known interatomic distances and the intensities of spots on X-ray oscillation photographs. The parameters of each atom are given. The K compound is isomorphous. The structure appears to contain $PbBr_2$ molecules and the angle between the two Pb-Br bonds calculated from the observed atomic parameters is 85½° ± 2°. This agrees with the value (90°) predicted by Pauling from wave-mechanics. J. I.

1457. Surface Structure of Silicon Carbide. G. I. Finch and H. Wilman. *Faraday Soc., Trans.* 33. *pp.* 337–339, *Feb.*, 1937.—It is shown experimentally that the electron diffraction halo pattern obtained from carborundum crystals is due to a superficial skin consisting in all probability of amorphous silica. Removal of the skin by abrasion or by quartz-etching reagents exposes the true carborundum crystal surface which then yields brilliant single crystal patterns. The skin is reformed by heating in an oxidising flame. Such an amorphous layer formed in a Bunsen flame was sufficiently thin to be semi-transparent to 50 kV electrons, the crystal giving a composite halo-single-crystal pattern. From this and the further experimentally established fact that a monomolecular layer of $C_{32}H_{66}$ is not fully penetrated by electrons of this speed at grazing incidence, it has been shown that the semi-transparent amorphous film was less than 43 Å in thickness. [See following Abstract.] AUTHORS.

1458. Nature of Polish. G. I. Finch. *Faraday Soc., Trans.* **33.** *pp.* **425–430,** *March,* **1937.**—Evidence is reviewed upon which was based the idea of the vitreous-like nature of polish. It is pointed out that the phenomenon of surface flow leaves open the question as to the state, whether amorphous or crystalline, of the flowing material or final polish layer. The fact that metallic polish yields halo patterns by electron diffraction is also inconclusive, because not only amorphous, but also certain crystalline metal films behave similarly. The ability, not exhibited by the corresponding crystalline surface, of metallic polish to dissolve metal crystals strongly supports the view of the amorphous state of both surface flow and polish, as does also the fact that the temperature of flow is limited by the melting-point of the metal. It has been shown experimentally that polishing results in flow on calcite single crystal surfaces, and that the polish layer is crystalline and integral in structure with the underlying crystal when the surface is a cleavage plane or is close in its direction to those of such a plane ; but affords, on the other hand, halo patterns when the polished surface is steeply inclined to all cleavage planes. Heating leads to the gradual emergence of a single crystal pattern through, and the eventual replacement of, the halo pattern. In view of the fact that the gradual formation of an amorphous skin on a silicon carbide crystal by a superficial oxidation is accompanied by the degeneration of the characteristic single crystal pattern into one of the halo type and *vice versa* on removal of the skin, it is concluded that the polish layer on a calcite surface remote in direction from any cleavage plane is amorphous. It is further concluded that surface flow is one of vitreous or liquid-like material, and that the crystalline structure of the polish layer on the calcite cleavage plane is due to recrystallisation of such flowed material under the influence of the underlying substrate crystal ; an influence which, however, is weak in surfaces steeply inclined to the directions of cleavage. [See preceding Abstract.] AUTHOR.

1459. Structure of Polished Metal Surfaces. S. Dobinski. *Phil. Mag.* **23.** *pp.* **397–408,** *March,* **1937.**—Polished metal surfaces are studied by electron diffraction. When the final polish is achieved by the use of a powdered oxide in the presence of water, the spacings corresponding to the pattern haloes agree with the measurements of earlier workers. The halo spacings afforded by this method of polishing are the same, within the experimental error, for all metals, whereas, if the polish layer is considered as an amorphous monatomic liquid, after Prins, the spacings should be determined by the atomic diameter of the metal. The author polished a series of metals on clean chamois under benzene, and obtained haloes which agreed with Prins' theory to within ± 4 % and differed from metal to metal. Metals polished in this manner were exposed to air for several hours, and it was found that the halo patterns then obtained were similar to those yielded by metals polished by the more usual method. It is therefore suggested that the normal halo patterns are due to the presence of an abnormally thick oxide layer produced during the polishing process, and that polishing in the absence of oxidising media gives rise to haloes typical of the metal itself. It is shown, in the case of Bi, that the haloes cannot be produced by submicroscopic crystals, and it is concluded that the surface and adjacent layers of a metal polished in the absence of oxidising media consist of a close-packed ensemble of the corresponding atoms irrespective of the normal crystalline structure, and, further, that the distance of closest approach of the atoms in this amorphous layer are equal to those in the crystalline structure of the metal in question. A. G. Q.

1460. Structure of Thiophosphoryl Bromide, $PSBr_3$. I. Nitta and K. Suenaga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 678. *pp.* 121–124, *Feb.,* 1937. *In English.*—The crystal $PSBr_3$ is investigated by means of Laue and oscillation photographs. It is found that the unit cube with the side $a = 11 \cdot 03$ Å contains 8 molecules and possesses the symmetry $T_h^6 - Pa3$. The density of the crystal from the X-ray data is 2·99. The atoms of P and S are located in the trigonal axes, and those of Br in general positions, the minimum molecular symmetry being $C_3 - 3$. The parameters for Br atoms are very roughly found to be either $x = 0$, $y = 0$, $z = \frac{1}{4}$, or $x = 0$, $y = \frac{1}{4}$, $z = \frac{1}{4}$, of which the former is more probable. With the first set of parameters, the crystal may be regarded as another example of the tin tetra-iodide structure. The intermolecular forces and the possible existence of associated double molecules are discussed. AUTHORS.

1461. Unit Cell and Space Group of Acetylsalicylic Acid. I. Nitta and T. Watanabê. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 679. *pp.* 125–128, *Feb.,* 1937. *In English.*—Oscillation and Weissenberg photographs give acetylsalicyclic acid, $C_6H_4(OCOCH_3)COOH$, a monoclinic unit cell of the dimensions $a = 11 \cdot 37$, $b = 6 \cdot 54$, $c = 11 \cdot 37$ Å, $\beta = 95 \cdot 7°$. This unit contains 4 molecules and possesses the symmetry of space group $C_{2h}^5 - P2_1/a$. The density of the crystal is calculated from these X-ray data to be 1·41. All the atoms are in general positions. A chain-like structure is suggested. The above result is completely different from that reported by Kôzu and Takané. AUTHORS.

1462. Relative and Absolute Spatial Configuration of Isomorphous, Optically-Active Complex Salts. Part I. F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 40. 1. *pp.* 2–11, 1937.—Werner's solubility rule is found to hold for both the triethylene- and tricyclohexanediamine-salts of cobalt and rhodium. An apparent exception to this rule, L – {Co (d–Chxn)$_3$} Cl_3, is explained as being caused by the superimposed action of the optically active base. In both the above series of salts the substitution of the central Co-atom by a Rh-atom causes, in addition to a change of magnitude, a reversal of the sign of the rotation when the substitution occurs in ions with the same absolute spatial configuration. J. I.

1463. Structure of Complex Salts of Racemic and Optically-Active Cyclohexane Diamines with Trivalent Cobalt and Rhodium. Part I. F. M. Jaeger and L. Bijkerk. *K. Akad. Amsterdam, Proc.* 40. 1. *pp.* 12–23, 1937.—Several derivatives, both optically active and racemic, of cyclohexanediamine are obtained and crystallographic data are given describing the form of the crystals obtained. Measurements of the rotatory dispersion of *d*- and *l*- cyclohexanediamine are described. J. I.

1464. Structure of Nickel Phthalocyanine. J. M. Robertson and Ida Woodward. *Chem. Soc., J. pp.* 219–230, *Feb.,* 1937.—The structure of nickel phthalocyanine is determined by a double Fourier synthesis of the X-ray crystal data for the (*h*0*l*) zone of reflections, employing absolute measurements of intensities and a direct determination of the phase constants by comparisons with free phthalocyanine [see Abstract 4483 (1936)]. The results are expressed by a contoured electron-density map of the molecule in which every atom is separately resolved. The 60 parameters of the structure are determined to within 0·02–0·04 Å. The molecule is planar, and its orientation in the crystal is practically identical with that of free phthalocyanine. The structure of the molecule is also closely similar to that of free phthalocyanine, but there is a definite inward shift, amounting to about 0·09 Å, of each of the four *iso*indole N atoms towards the central Ni atom to which they are bound by covalent links. The C-N interatomic distance of the inner nucleus is 1·38 Å, slightly greater than the value found for free phthalocyanine. The molecule is more nearly tetragonal than free phthalocyanine, but a small deformation still exists. The structures assigned to nickel phthalocyanine and free phthalocyanine have been verified by the calculation of all the structure factors from the coordinates of the atoms. Some electron counts are given.

1465. Structure of Triphenylene. S. Banerjee and A. C. Guha. *Zeits. f. Krist.* 96. 2–3. *pp.* 107–110, 1937. *In English.*—Triphenylene crystallises in the orthorhombic bipyramidal class. Its unit cell has the dimensions $a = 13\cdot20$, $b = 16\cdot81$, $c = 5\cdot26$ Å, and it contains 4 molecules of $C_{18}H_{12}$. The principal magnetic susceptibilities of the crystal along its *a*, *b*, and *c* axes are $-150\cdot1 \times 10^{-6}$, $-149\cdot5 \times 10^{-6}$, and $-174\cdot2 \times 10^{-6}$ respectively, per gm. mol. From these data the approximate orientations of the triphenylene molecules in the unit cell are derived; the normals to the planes of the molecules are inclined at about 51° to the *c* axis, and are equally inclined (at about 57°) to the *a* and the *b* axes. AUTHORS.

1466. X-Ray Study of Linear Polyesters. C. S. Fuller and C. L. Erickson. *Am. Chem. Soc., J.* 59. *pp.* 344–351, *Feb.*, 1937.—By drawing out fibres of some polyesters of high molecular weight X-ray fibre diagrams are obtained showing a high degree of orientation in the fibres. The chain molecules are orientated with their lengths parallel to the fibre axis. The chain atoms in polyethylene succinate are shown to possess a helical arrangement in contrast to the chains in polyethylene-adipate, azelate and sebacate which have configurations deviating only slightly from the plane zigzag form. The table gives the minimum values for the unit cells obtained by a graphical method from the fibre diagrams.

	a (Å)	(*b*) Å	(*c*) Å	β
P-ethylene succinate	9·05	11·09	8·32	102·8°
P-ethylene adipate	25·7	30·7	11·71	103·8°
P-ethylene azelate	25·7	30·7	31·2	103·8°
P-ethylene sebacate	25·7	30·7	16·67	103·8°
P-trimethylene sebacate ...	31·2	31·2	33·5	90°
P-diethylene oxide sebacate	17·6	17·6	38·0	90°

c is the direction of the fibre axis. J. I.

1467. X-Ray Study of Protein Structures. H. Mark and H. Philipp. *Naturwiss.* 25. *pp.* 119–124, *Feb* 19, 1937.—A review of the results obtained in recent years by X-ray crystal analysis of the structure of proteins. The authors summarise the data obtained by Astbury and others on the molecular structure of fibrous and soluble proteins and on their mechanical properties. J. I.

1468. Formation of Dehydration Nuclei on Crystals of Chrome Alum. J. A. Cooper and W. E. Garner. *Faraday Soc., Trans.* 32. *pp.* 1739–1744, *Dec.*, 1936.—Measurements are made of the rates of growth of the spherical nuclei formed on dehydration of crystals of chrome alum. The nuclei have been shown to grow at an accelerating rate up to 10^{-2} cm., and then to increase in size at a linear rate. The causes underlying the accelerating rate of growth are, however, obscure. The presence of a tension in the interface depressing the dissociation pressure would, however, account for the results obtained, and on applying the Kelvin equation a value of $7\cdot49 \times 10^{6}$ dynes/cm. is obtained for the tension.

The bearing of the results on the induction periods in solid reactions is discussed. AUTHORS.

1469. Velocity of Crystallisation from Supersaturated Solutions. A. N. Campbell and Alexandra J. R. Campbell. *Faraday Soc., Trans.* 33. *pp.* 299–308, *Feb.,* 1937.—Using supersaturated solutions of barium succinate the following phenomena are studied: (1) Tendency towards spontaneous crystallisation. (2) The velocity of crystallisation after inoculation with a constant weight of inoculant. The velocity increased with degree of supersaturation, and showed no tendency to approach a maximum up to 1500 % supersaturation. The values of the velocity " constants " lead us to modify somewhat the diffusion hypothesis of Noyes and Whitney. (3) The velocity of crystallisation is shown to be decreased by increasing the viscosity of the medium, and probably increased by lowering the surface tension. (4) The protective action of a colloidal addition (agar) is examined quantitatively. AUTHORS.

1470. Effect of Small Quantities of Metallic Oxides on Crystallisation of Zinc Borate. R. Pâris and P. Mondain-Monval. *Comptes Rendus,* 204. *pp.* 579–581, *Feb.* 22, 1937.—The effect of small additions (*e.g.,* 0·5 %) of various oxides on the velocity of crystallisation of $3ZnO \cdot 2B_2O_3$ at various temperatures has been determined. It is increased by the oxides of Li, Na and K, slightly diminished by those of Be, Mg, Ca, Sr, Ba, Zn or Cd, and markedly so (to a degree increasing in the order noted) by those of Al, Ce, U, Sn, Dy, W, Th. Mo, Tl, Bi, Zr, Co, (Er + Y), Ni, Cu, Fe, Ti, Mn and Cr; unaltered by that of Pb. Further addition causes increased action, but in less than linear proportion. The degree of oxidation has an effect, thus oxides of Ce, U or W had little effect when heated in the oxidising flame, but hinder crystallisation if heated in the reducing flame. C. A. S.

1471. Electrolytic Growth of Metal Crystals. Part II. T. Erdey-Grúz and R. F. Kardos. *Zeits. f. phys. Chem.* 178. *Abt.A.* 4. *pp.* 255–265, 1937.—Continuing previous work [see Abstract 1371 (1935)] the authors investigate the electrolytic growth of Ag crystals from molten Ag salts. Well-formed crystals with sharp points and edges are obtained from molten $AgNO_3$ and from molten mixtures of this salt with KNO_3, AgCl, AgBr and AgI. The crystals are combinations of (3 1 1), (1 0 0) and (1 1 1). The normal velocity of growth of the surfaces diminishes in the order given. Not all of the surfaces predicted by the Stranski theory appear and the order of increasing velocity of growth is different from that predicted by the theory. No electrolytic crystal growth is observed with molten silver halides. Current-voltage curves are investigated and photographs of the crystals are reproduced. [See following Abstract.]
L. A. W.

1472. Electrolytic Growth of Metal Crystals. Part III. T. Erdey-Grúz and E. Frankl. *Zeits. f. phys. Chem.* 178. *Abt.A.* 4. *pp.* 266–273, 1937.—An account is given of investigations of the electrolytic growth of spherical single crystals of Cu from solutions of various Cu salts. No regular growth is observed from cupric salt solutions, but well-formed crystals are obtained from complex solutions of CuCl and CuBr with other halides. Unsatisfactory results are obtained, however, with CuI in KI and CuCN in KCN. Deviations from the Stranski theory are observed. Enlarged photographs of the crystals are reproduced and current-voltage curves given. [See preceding Abstract.]
L. A. W.

1473. Theory of Coloured Crystals. D. Blochinzew. *Phys. Zeits. d. Sowjetunion*, 10. 4. *pp.* 431–441, 1936. *In German.*—A mathematical discussion of the conditions governing the appearance of colour centres in crystals is followed by the derivation of a formula for the mobilities of the F-centres. For an alkali-halogen crystal the theoretical value for the mobility is of the order 10^2 cm./sec./volt/cm. which agrees with the value observed. J. I.

1474. Effect of Artificial Damage to the Surface on the Strength of Rock-Salt. M. W. Classen-Nekludowa. *Phys. Zeits. d. Sowjetunion*, 10. 4. *pp.* 442–461, 1936. *In German.*—Water is found to penetrate into rock-salt crystals and, when cleaved, the effect on the crystals of drying by various methods is investigated. The surface of the crystals is also scratched and the effect on the strength and elasticity recorded. [See following Abstract.] J. I.

1475. Influence of Fixation of Plastic Flow on the Strength of Moistened Rock-Salt. M. W. Classen-Nekludowa. *Phys. Zeits. d. Sowjetunion*, 10. 4. *pp.* 462–483, 1936. *In German.*—Measurements of tensile strength show that rock-salt undergoes plastic deformation when extended in the directions [100] and [111]. The deformation curve has been investigated under varying conditions. No change is noted in the elastic coefficient of moistened rock-salt in comparison with the dried crystals. The fracture of dried rock-salt appears to be due to the formation of glide tracks and this corresponds to the beginning of flow in the moistened crystals. [See preceding Abstract.] J. I.

1476. Adsorption and Abnormal Properties of Crystals. A. Ganguli. *Zeits. f. Krist.* 96. 2–3. *pp.* 225–227, 1937. *In English.*—It is suggested that adsorption of impurities, either external or internal, may be the cause of the imperfections of most crystals, and 11 different ways in which adsorption might bring this about are enumerated. [See Abstracts 4805 (1934) and 3201 (1935).] C. A. S.

1477. Effect of Orientation on Crystal Strength. H. L. Cox and D. G. Sopwith. *Phys. Soc., Proc.* 49. *pp.* 134–151, *March* 1, 1937.—A method of tabulating resolved shear stresses for any type of slip system is devised. Diagrams of maximum resolved shear stress for torsion and tension as functions of orientation are drawn both for the case of Al with slip plane of type (111) and slip direction of type (110), and for the case of Fe with slip direction of type (111) and slip any plane. Similar diagrams of harmonic mean stress in torsion also are drawn. The effect of different criteria of failure in indicating the failure of polycrystalline specimens is investigated. If elastic failure of polycrystalline specimens is determined entirely by the maximum resolved shear stress developed locally, the ratio of the yield in torsion to the yield in tension should be 0·500; whereas if elastic failure is determined by the complete yield of all the crystals of the specimen, the value of this ratio should be about 0·577. AUTHORS.

***1478. Glide in Metal Single Crystals. E. N. da C. Andrade and R. Roscoe.** *Phys. Soc., Proc.* 49. *pp.* 152–176; *Disc.*, 176–177, *March* 1, 1937.—A method is described for producing single crystals of Cd and of Pb which are not affected by annealing, and, in general, show great regularity of mechanical behaviour. A simple recording extensometer also is described. With the Cd crystals very consistent results are obtained, and the effects of rate of glide and of impurities on the measured critical shear stress are investigated. Experiments are carried out on hardening and recovery of the Cd crystals, and on the spacing of glide planes in lead crystals, which has been shown to be independent of a range of factors, and so to have a physical significance. It is shown that the results relating to hardening can be explained by a hardening on individual glide lamellæ which is proportional to the glide, and it is suggested that the mechanism of the permanent hardening is mainly a rotation of crystallites in the lamellæ. AUTHORS.

See also Abstracts **1421, 1440, 1483, 1504, 1604, 1676, 1685, 1705, 1788, 1789, 1791, 1822, 1825, 1826.**

DENSITY.

1479. Specific Volumes of D_2O and its Ice. T. Takeuchi and T. Inai. *Japanese Journ. Phys.* 11. *pp.* 67–68, *Dec.*, 1936. *In English.*—The difference of specific volumes of D_2O and its ice is measured. AUTHORS.

1480. D_2O-Content of Atmospheric Moisture. K. Okabe and T. Titani. *Chem. Soc. Japan, Bull.* 12. *pp.* 11–15, *Jan.*, 1937. *In German.*—The density of water condensed from the atmosphere in 22 experiments spread over 10 months, under a variety of weather conditions, was lower than that of ordinary water by a varying amount (1–7γ). The mean density difference is in the direction anticipated and the variation is to be ascribed to variations in original rate of evaporation. L. V. C.

1481. Densities of Fine Powders. J. L. Culbertson and A. Dunbar. *Am. Chem. Soc., J.* 59. *pp.* 306–308, *Feb.*, 1937.—Measurements of the apparent densities of charcoal and silica gel in water, CCl_4, benzene, and petroleum ether have been made. The liquids, water and petroleum ether, which, respectively, show the highest and lowest apparent densities for silica yield values of the opposite order for charcoal. Some existing theories are examined in the light of the data found and a new postulate advanced. AUTHORS.

See also Abstracts **1401, 1460, 1461, 1793.**

DIFFUSION AND OSMOSIS.

1482. Diffusion of Hydrogen through Palladium. A. Farkas. *Faraday Soc., Trans.* 32. *pp.* 1667–1679, *Dec.*, 1936.—The rate of diffusion of H_2 through a Pd disc and tube is compared with the rate of conversion of parahydrogen at 20° to 320° C. and about 20 mm. Hg. It is assumed that three processes are involved, (*a*) sorption of H_2 on the surface of the metal with dissociation of the gas into atoms; (*b*) diffusion through the metal, and (*c*) desorption from the boundary of the metal with recombination of molecules from the atoms. Two characteristic cases are distinguished in which the parahydrogen conversion is (1) 3 to 4 times quicker than the diffusion, (2) very much faster than the diffusion. In the former, the boundary dissociation of the gas molecule is the rate-determining step for the diffusion; in the latter the rate of diffusion is governed by the actual transfer of the atoms through the metal. The two sides of the Pd may have entirely different catalytic activities. The energies of activation for the Pd disc were: for sorption 5·8 k.cal., for transfer 4·1 k.cal. and for desorption 3·3 k.cal. G. E. A.

1483. Diffusion of Colouring Matter in Phthalic Acid Crystals on Heating. P. Gaubert. *Comptes Rendus,* 204. *pp.* 599–601, *Feb.* 22, 1937.—The changes in appearance that occur on heating a crystal of phthalic acid, crystallised from a solution thereof containing a dye (*e.g.*, methyl red), are described. The dye appears partly to separate out in an amorphous form, but along definite planes of the crystal, and partly to crystallise out in crystals oriented similarly to those of the phthalic acid. C. A. S.

***1484. Diffusion in Fast Streaming Vapours. D. MacGillavry.** *Faraday Soc., Trans.* 33. *pp.* 433–439, *March* ,1937.—The principle of a new diffusion chamber for diffusion in fast streaming vapours is given. The physical theory is discussed, the proper boundary conditions are determined and the corresponding solutions derived and examined. A useful approximation for rapid numerical calculations is given. AUTHOR.

1485. Osmotic and Activity Coefficients. K. Ariyama. *Chem. Soc. Japan, Bull.* 12. *pp.* 44–51, *Jan.*, 1937.—The osmotic pressures and the activity coefficients for strong electrolyte solutions and for solutions of mixtures of electrolytes and non-electrolytes at the surface are calculated on the basis of the Debye-Hückel theory. Some relations between the activity coefficients for two cases are given. AUTHOR.

1486. Osmotic Pressure and Gas Pressure. K. H. Meyer. *Zeits. f. Elektrochem.* 43. *pp.* 148–152, *March,* 1937.—From a theoretical comparison of osmotic pressure and gas pressure it is concluded that the former is due to thermal impacts of the dissolved molecules upon the semi-permeable membrane, just as the latter is due to impacts upon the containing walls. The osmotic pressure of N_1 molecules in ideal mixture with N_0 molecules is equal to the pressure exerted by N_1 molecules of a force-free gas having a free volume of N_0 molecular places at its disposal. Thus both osmotic and gas pressure have the same ultimate cause, *i.e.*, thermal motion, there being an analogy between the diffusion of solute into solvent and gas into free space. L. A. W.

1487. Osmotic Pressure of Gum Arabic. H. B. Oakley. *Faraday Soc., Trans.* 33. *pp.* 372–381, *March,* 1937.—The osmotic pressure of acid gum arabic and of the Na, K, Li and Ca salts are measured up to a concentration of 10 % of gum. The pressure-concentration curve of Na-gum shows a sudden increase of slope below a concentration of 0·25 % and a similar effect is shown by acid gum. Data for the other gum salts at such low concentrations have not been obtained. The possibility of explaining this by dissociation of the gum particle is discussed. The apparent ionisation calculated from the results passes through a minimum. This is attributed to change of activity and a subsequent increase of ionisation due to the overlapping of the atmosphere of gegenions. The maximum electrovalency is 200 (particle wt., 240,000). 5 % solutions have the following effective electrovalencies per particle: Ca-gum 25; H 26; Na, K, Li, 82 to 90. A qualitative correlation of these results with the conductivity data of D. R. Briggs is discussed. It is shown that the osmotic " activity " of the H ions of the acid gum is much lower than the corresponding electrochemical activity (as published) up to 6 % concentration. [See also Abstract 4501 (1936).] AUTHOR.

***1488. Membrane Permeability. Part I. E. J. Hartung, F. H. C. Kelly and J. Wertheim.** *Faraday Soc., Trans.* 33. *pp.* 398–405, *March,* 1937.—An apparatus for the accurate measurement of diffusion rates of solutes through membranes is described, and its advantages over previously used methods are discussed. AUTHORS.

See also Abstract 1424.

ELASTICITY AND PLASTICITY.

1489. Dynamical Effects and Ellipses of Elasticity. G. M. Pugno. *Accad. Sci. Torino, Atti*, 72. *Disp.* 1a. *pp.* 87–95, *Nov.–Dec.*, 1936.—A mathematical discussion is given of the deformations that an elastic solid undergoes through forces accelerating it, and through those of inertia first produced. The deformations are considered as the effect of forces acting in a manner exclusively static on the solid itself, whose elastic conditions have been corrected with the addition of special elastic masses, by way of extending, as is completely done in special cases, the theory of ellipses of elasticity to dynamical problems. [See following Abstract.] J. J. S.

1490. Dynamic Effects and Pulsating Elastic Weights. G. M. Pugno. *Accad. Sci. Torino, Atti*, 72. *Disp.* 1a. *pp.* 120–127, *Nov.–Dec.*, 1936.—Referring to his previous paper [see preceding Abstract], in which it is shown that dynamical deformation may be regarded at every instant as the static deformation produced by accelerating forces but in presence not only of the fixed elasticity of the system but also of certain secondary elastic weights, the author in the present paper considers the phenomenon not now as relating to the instant but in its development in time, and studies and defines the variations of such secondary elastic weights, which on account of this mode of action he calls pulsating. J. J. S.

1491. Stress Distribution in a Heavy Disc Held with its Plane Vertical by a Peg at the Centre. S. Ghosh. *Calcutta Math. Soc., Bull.* 28. *pp.* 145–150, *Sept.–Dec.*, 1936.—Solves this problem as one in generalised plane stress, in the two cases where the peg is a forced fit, and a just loose fit. W. G. B.

1492. Two-Dimensional Problems of Elasticity. S. Ghosh. *Calcutta Math. Soc., Bull.* 28. *pp.* 213–222, *Sept.–Dec.*, 1936.—Solves the following problems in generalised plane stress :—(1) a heavy disc resting in a vertical plane on two pegs at the circumference ; (2) a heavy disc with a concentric hole resting on a horizontal plane. In the second case, point contact only is assumed. W. G. B.

1493. Flexure of a Hollow Shaft. Part II. B. R. Seth. *Indian Acad. Sci., Proc.* 5A. *pp.* 23–31, *Jan.*, 1937.—A complete mathematical solution for the flexure of a hollow shaft with a cavity placed eccentrically has been given in Part I [see Abstract 476 (1937)], and in Part II the amount of twist produced, the value of the stress at different parts of the section and the lines of shearing stress are worked out. H. J. H. S.

1494. Effect of Pressure on the Modulus of Rigidity of Metals and Glasses. F. Birch. *J. of Applied Physics*, 8. *pp.* 129–133, *Feb.*, 1937.—The effect of pressure on the modulus of rigidity has been determined for five metals and two glasses, to 4000 kg./cm^2., by a dynamical method. The corrections due to the viscous motion of the pressure medium are computed approximately and shown to be negligible. Absolute values of the dynamical Young's modulus and modulus of rigidity are also given, and the derived compressibilities compared with directly measured compressibilities. AUTHOR.

1495. Colloidal Nature of Asphalt as Shown by its Flow Properties. R. N. Traxler and C. E. Coombs. *J. Phys. Chem.* 40. *pp.* 1133–1148, *Dec.*, 1936.—Some asphalts appear to be truly viscous. Others exhibit varying degrees of anomalous flow. The source of the asphalt, the degree of processing, and the temperatures and rates of shear at which the measurements of flow are made influence the magnitude of such flow characteristics as thixotropy, age-hardening, quasi-viscosity, and elasticty. The presence of flow properties supports the concept that asphalts are distinctly colloidal. For truly viscous asphalts the change of viscosity with decreasing temperature is continuous with no sudden change from a sol to a gel condition or from a semi-solid to a solid state. References are given to 29 papers. J. K.

1496. Rheological Properties of Materials of Great Consistency Such as Asphalts. E. Thelen. *J. of Applied Physics*, 8. *pp.* 135–137, *Feb.*, 1937.—When an ASTM penetrometer needle is allowed to sink into a material such as asphalt for a series of successive time intervals, the rate of flow varies linearly with the shearing stress as calculated from the equations: $a = 7\cdot854 \times 10^{-5}(Pf - Pi)/t$,

$$b = 0\cdot098 \times 10^{4}W/[0\cdot001571(Pf + Pi) - 0\cdot0521],$$

where a = rate of flow in cm³/sec.,
b = shearing stress in dynes/cm².,
Pf = final penetration during interval t, in dmm.,
Pi = initial penetration during interval, t in dmm.,
t = time interval in sec.,
W = weight of needle and instrument head in gm.

The first penetration in hard materials and the first several penetrations in soft materials give erratic data; otherwise no systematic errors have been observed, and accuracy depends upon the skill of the operator. As expected from plastometric theory and from previous work by other investigators: (1) Results are almost independent of the shearing stress used; (2) The mobility is affected by the shape of the surface of the material at the point of punch, while the yield value is unaffected; (3) Minus log m, which is mathematically equal to log viscosity when $f = 0$, varies linearly with the temperature. (4) Yield values for asphalts from a particular crude stock vary linearly with the per cent asphaltene content—the concentration of zero yield value being at 21·8 %. (5) On ageing, an asphalt increases in yield value and decreases in mobility. The author finds that on air-blowing two particular charge stocks, the melting point can be predicted from the mobility at 77° F.: $MP = (-\log m - r)/s + 77$, when r and s are constants characteristic of the charge stock.
AUTHOR.

1497. Shearing Phenomena at High Pressures, Particularly in Inorganic Compounds. P. W. Bridgman. *Am. Acad., Proc.* 71. 9. *pp.* 386–460, *Jan.*, 1937.—Gives additional information as to technique, and details of results for upwards of 250 inorganic compounds [see Abstract 84 (1936)]. W. G. B.

1498. Transverse Vibration of Freely Supported Rectangular Plates under the Action of Moving Loads and Variable Forces. B. Sen. *Calcutta Math. Soc., Bull.* 28. *pp.* 199–208, *Sept.–Dec.*, 1936.—The general solution of the equations of motion, with transverse forces or pressures varying with time, is obtained, and particular solutions for a periodic concentrated force, a periodic pressure, a constant force whose point of application moves uniformly parallel to one side, and a moving, pulsating concentrated force are worked out in detail. W. G. B.

1499. Solution of Boundary Problems for the Wave Equation and the Theory of Elasticity in the Cases of the Circle and the Sphere. V. I. Smirnov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 1. *pp.* 13–16, *and* 14. 2. *pp.* 69–72, 1937. *In*

French.—Obtains formal solutions of the wave equation in two and three dimensions, in terms of the boundary values over the circle or sphere respectively, and applies the formula to the case of elastic waves consequent on given displacements at a circular or spherical internal boundary.
W. G. B.

1500. Fundamental Vibration of a Membrane. J. Barta. *Comptes Rendus,* 204. *pp.* 472–473, *Feb.* 15, 1937.—Taking the equation for the vibration of a membrane $\Delta u + \lambda u = 0$ for the region S with the limiting condition at the boundary of $u = 0$ for $s = S$ a simple procedure is given to obtain the upper and lower limits for the minimum value of $\lambda = \lambda_1$. The results are applied numerically to an elliptical membrane. R. S. R.

1501. Strain in Glass. Niuta Klein. *Rev. d'Optique,* 15. *pp.* 281–297, *Sept.,* 1936.—Strain is almost always identified with forces produced by viscosity during more or less rapid cooling. It is accompanied by the co-existence of two allotropic forms, α, stable when cold, and β, stable when hot, which have differing physical constants. The proportions are determined by the temperature and pressure, and if these vary the physical constants also change. An unstable glass in which the constants may vary rapidly can be obtained by sudden cooling. F. S.

1502. Fracture of Glass Plates by Percussion. T. Okaya and K. Ishiguro. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 53–71, *Jan.,* 1937. *In French.*—A cylindrical weight with a needle point at the bottom of the axis was dropped from varying heights on to plates of glass, 5 × 5 cm. and 2 and 3 mm. thick, and the forms of the percussion figures, in particular the radial fractures, observed. The connection between the numbers and positions of such fractures and the percussion force as deduced from several hundred experiments is discussed with the aid of elaborate mathematics. Results seem to show that the number of such fractures is at first practically independent of the force, but tends finally to increase as it increases.
C. A. S.

1503. Tensile Strength of Glass as a Probability Problem. W. Harries. *Zeits. f. techn. Physik,* 18. 2. *pp.* 48–54, 1937.—A consideration of the present knowledge of the tensile strength of glass leads to the formulation of a probability law for the value of the tensile strength. A number of theoretical deductions are made and these are compared with the experimental results of several workers, notably Borchard; satisfactory agreement is found. H. J. H. S.

1504. Surface Cracks in Glasses. E. N. da C. Andrade and L. C. Tsien. *Roy. Soc., Proc.* 159*A*. *pp.* 346–354, *April* 1, 1937.—The attack of hot sodium vapour develops on the surface of hard glasses a series of fine lines, which by their nature, position and direction cannot be attributed to mechanical scratches. These lines are not found with glass freshly drawn at high temperature, but are frequent on the same glass after it has been kept for some hours. They are attributed to fine surface cracks, arising spontaneously in the manner suggested by Griffith. On annealed optical glass they form an orthogonal system, and this and other evidence suggests that they arise in directions normal to the principal stresses (tensions). Other surface markings, such as scratches and drawing marks, can be developed by the attack of hydrofluoric acid; the Griffith cracks cannot be so brought to light. It is suggested that etching by hot sodium vapour may be a valuable method of investigating the structure of glasses.
AUTHORS.

1505. Tensile Strength of Quartz Fibres. O. Reinkober. *Phys. Zeits.* 38. *pp.* 112–122, *Feb.* 15, 1937.—In continuation of previous work [see Abstract 1829 (1932)], the following facts are established experimentally: (1) By etching the surface of quartz fibres, the tensile strength and, in a smaller degree, the elastic moduli of the fibres are increased. (2) A minimum thickness of surface must be removed before a maximum value of the tensile strength is attained. The original lower value of the tensile strength is recovered after a long interval. (3) If the tensile strength is measured while the etching HF is present on the fibres in air, then its value is increased apparently only slightly. (4) Adsorbed surface layers reduce the tensile strength, which increases when the surface layers are removed *in vacuo*. (5) The effect of the adsorbed layer is brought about by joint action with a surface layer of the fibre. (6) Measurements of the flexural rigidity indicate the effect of superficial irregularities; the increase of rigidity with decreasing diameter of the fibres is attributable, at least in part, to the presence of these irregularities. J. S. G. T.

***1506. Elastic Vibration Apparatus. C. W. Kosten and C. Zwikker.** *Physica*, 4. *pp.* 221–234, *March*, 1937. *In English.*—After an introduction dealing with mechanical vibrating systems, an apparatus is described for determining the plastic and elastic behaviour of elastic substances (for example: rubber, cork, felt, etc.). In principle this apparatus is a mechanical vibrating system, consisting of a mass M, resting on the elastic material to be investigated. To M a vertical force is applied of a sine-like alternating nature and the vertical vibrational amplitude of M is measured, as regards magnitude and phase (with respect to the force), by transforming distance-variations into capacity-variations. From these observations the internal friction and the compliance of the substances in question are calculated. The measured quantities are required, among other things, for the computation of the vibrational insulation of machines, as obtained by their elastic mounting and also for shock-absorbing constructions. AUTHORS.

See also Abstract 1551.

HYDRODYNAMICS AND AERODYNAMICS.

1507. Fluid Motion. A. Fage. *Phys. Soc., Reports*, 3. *pp.* 26–41, 1936.—Progress review.

1508. Model Split Flap Aerofoil—Comparison with Full-Scale. J. D. Graham. *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 94–109, *Jan.*, 1937.—This paper is an interim report on a full investigation of the "flap-shut" characteristics of a model aerofoil of modified Clark Y H section, by pressure determination in an open jet, closed-circuit wind tunnel; the object was to correlate the model lift curve with that for full-scale, as a preliminary to an investigation upon split flaps. AUTHOR.

1509. Conical Shock Wave Formed by a Cone Moving at a High Speed. J. W. Maccoll. *Roy. Soc., Proc.* 159*A*. *pp.* 459–472, *April* 1, 1937.—The work of an earlier paper [see Abstract 1720 (1933)] on the flow past a cone at supersonic speeds is reviewed in the light of results from photographs of two-pounder projectiles in flight and it is found that the calculated and observed positions of the shock wave are in very good agreement. The methods described in the previous paper are then applied to calculate the shock wave conditions which can exist with cones of vertical angle 80°, 90°, 100° and 110°, and it is found that a conical shock wave

V.
19

cannot be formed at the tip of a cone when the apex angle exceeds 115·2°. The main results obtained in both the present and earlier papers are summarised in two diagrams. AUTHOR.

1510. Stability of Quadratic Velocity-Distributions for an Inviscid Liquid Flowing between Parallel Planes. J. L. Synge. *J. Math. Phys.* **15.** *pp.* **205–210,** *Nov.,* **1936.**—A two-dimensional disturbance is superposed on a flow between parallel planes $y = \pm b$, the disturbance being periodic or localised in the sense that, if ω' represents the vorticity of the disturbance, $\iint \omega'^2 \, dx dy$ over the whole region between the planes converges. It is proved that this integral, taken over a wave-length in the x-direction and between the planes, or over the whole region between the planes, as the case may be, is a constant (independent of the time) if the initial velocity u_0 is a quadratic function of y. From this result the stability of the motion is deduced. Consideration is also given to a quantity called the "deviation" of the motion, which relates to the mean square of the deviation of the lines of constant vorticity from their undisturbed position. The paper closes with a criticism of the application to the problem of hydrodynamic stability of the usual method of small periodic oscillations. S. G.

1511. Heterogeneous Fluid Masses in Rotation. P. Dive. *Comptes Rendus,* **204.** *pp.* **405–407,** *Feb.* **8, 1937.**—In this paper the author criticises a recent publication by Gardedieu [see Abstract 1029 (1937)] on heterogeneous fluid mass in rotation. In it Gardedieu has affirmed that stratification into ellipsoidal surfaces of revolution is never rigorously realised, and has erroneously identified the author as supporting the general proposition. The author now points out that in 1927, he had established that the ellipsoidal stratifications might be produced by permanent rotations under certain conditions, but he supplies a historical *résumé* to prove that the general proposition was never affirmed by him. H. H. Ho.

1512. Propagation of Motion in Viscous Media. L. Cagniard. *Comptes Rendus,* **204.** *pp.* **408–410,** *Feb.* **8, 1937.**—Duhem has demonstrated the impossibility of the propagation of discontinuities in a viscous medium, but when the coefficients of viscosity are very small, a quasi-wave could be assumed to take the place of a true wave in which what was equivalent to a discontinuity appeared to be propagated. For such a quasi-wave it was necessary that its depth should be of infinitesimal order or at most equal to that of the viscosity coefficients. These very general conclusions were examined by Roy for a particular case limited to small motions given by the equation : $a^2 \, \partial^3 u/\partial x^2 \partial t + v^2 \, \partial^2 u/\partial x^2 - \partial^2 u/\partial t^2 = 0$. The author now endeavours to complete the work of Roy by resolving the mixed typical problem, which is best adapted to the experimental conditions under which the birth of a progressive wave occurs. H. H. Ho.

1513. Measurements of Eddy Flow in the Region of Bends. S. Eicke and W. v. Treuenfels. *Forsch. Ing.Wes.* 8. *pp.* 6–9, *Jan.–Feb.,* 1937.—An experimental investigation of turbulent air flow in the region of bends, by means of a small three-vaned anemometer is detailed. Three regions of flow are distinguished : (1) one in which the vanes are perfectly still, (2) one in which the vanes rotate more or less uniformly, and (3) one in which the vanes rotate irregularly backwards and forwards. Single and double bends are investigated. J. S. G. T.

1514. Investigation of Flow by Means of the Ultra-Microscope. G. Vogelpohl and D. Mannesmann. *Forsch. IngWes.* 8. *pp.* 42–47, *Jan.–Feb.,* 1937.—The method devised by Fage and Townend of employing the ultra-microscope in the investigation of fluid flow [see Abstract 3085 (1932)] is developed so as to yield photographs, capable of measurement, of fluid flow. The motion is rendered more easily photographed by the addition of about 0·1 gm. of Al powder (size of grain, about 10 μ) to each 100 l. of water employed in the flow. The method is applied to investigate laminar flow in a tube of circular cross-section, and the results obtained are compared with experimental and theoretical results obtained by others. Turbulent flow in the tube is very briefly referred to. J. S. G. T.

1515. Calibration Errors in Hydrometric Vane Current Meters. L. Escande and G. Sabathé. *Comptes Rendus*, 204. *pp.* 477–479, *Feb.* 15, 1937.—The effect of a limited width of canal on the readings of a hydrometric vane current meter which is calibrated in it is studied by means of observations made with an Ott current meter in a channel 24 cm. wide. The effect of depth of immersion in the channel is studied, and it is found that a maximum percentage error occurs at all depths at an appropriate velocity of transport of the meter. [See also Abstract 1039 (1937).] J. S. G. T.

1516. Resistance to Flow of Water along Smooth Rectangular Passages, and the Effect of a Slight Convergence or Divergence of the Boundaries. J. Allen and N. D. Grunberg. *Phil. Mag.* 23. *pp.* 490–503, *March*, 1937.—The experiments of Cornish [see Abstract 381 (1929)], Davies and White [see Abstract 2250 (1928)], and the authors confirm the theory of resistance in laminar flow through rectangular pipes of various sections provided the flow is of the nature visualised in the theory. The lower critical velocity is inversely proportional to the ratio of the maximum velocity to the mean velocity in the cross-section during laminar flow. For moderate ratios of side dimensions (Cornish, 2·92; Allen and Grunberg, 3·92), the resistance R, in turbulent flow for which vm/ν lies between 1,000 and 5,000, is given by $R/\rho v^2 = 0{\cdot}0247\,(\nu/vm)^{0.24}$. The theory developed for slightly convergent or divergent boundaries is confirmed by experimental results obtained at sufficiently low Reynolds numbers (< 1500). Points of breakdown occur, followed by a region of approximate conformity with the law, corresponding with the narrow end of the channel. The slight divergence of the channel is found to promote eddy-loss which increases resistance in the transition state and after establishment of "fully turbulent" conditions; slight convergence gives results in the turbulent region approaching those of the equivalent uniform section. J. S. G. T.

1517. Visible Air-Flow. S. Eicke and R. Wille. *Forsch. IngWes.* 8. *pp.* 10–12, *Jan.-Feb.*, 1937.—Metaldehyde is shown to be especially suitable for rendering visible the details of air flow. Its application to investigate flow in motor cylinders and in flow past obstructions is exemplified. J. S. G. T.

See also Abstracts 1526, 1527, 1576.

KINETIC THEORY OF MATTER.

1518. Methods for Operating Beams of Atoms and Ions. R. Ritschl. *Phys. Zeits.* 38. *pp.* 141–157, *March* 1, 1937.—Comprehensive, historical, illustrated review of the methods for producing, analysing and focussing beams of atoms and ions. F. C. C.

See also Abstracts 1486, 1714.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstracts 1478, 1561.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1519. Fourier Integral. T. Sakurai. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 706–726, *Dec.*, 1936.—The Fourier integral of the form $(1/2\pi i) \iint f(\xi)K(x, \xi, \lambda)d\xi d\lambda = (1/2)[f(x+0) + f(x-0)]$ is discussed, and applied to the solution of problems including heat flow, the method of images, and Stokes' method for boundary value problems. P. H. B.

1520. Tensors Associated with a Pair of Quadratic Differential Forms. E. S. Akeley. *Frank. Inst., J.* 223. *pp.* 199–214, *Feb.*, 1937.—A pair of quadratic differential forms determine, at least partly, at each point of an n dimensional space a set of n invariants and a set of n orthogonal unit vectors. Tensors associated with the two forms can be expressed in terms of these quantities. The properties of such tensors are developed by the application of Galois group theory. G. C. McV.

1521. Solution of $\nabla^2 \phi - (1/c^2)\, \delta^2\phi/\delta t^2 = -a$. W. F. G. Swann. *Am. Phys. Teacher*, 5. *pp.* 27–28, *Feb.*, 1937.—The method avoids the use of certain analytical devices which seem artificial to many physicists. The essential elements of the proof involve a transformation from coordinates x, y, z, t, to coordinates $\xi = x$, $\eta = y$, $\zeta = z$, $\tau = t \pm r/c$, followed by a use of a well-known three-dimensional form of Green's theorem. The remainder of the proof involves only straightforward algebraical reductions and integrations. AUTHOR.

1522. Consistency of Independent Countings as a Criterion for Completeness. T. C. Fry. *J. Math. Phys.* 15. *pp.* 211–217, *Nov.*, 1936.—The problem originates in the checking of proof-sheets for errors in a set of mathematical tables and is one of inverse probabilities, and may be solved by a consistency criterion known as "goodness of fit." A set of p_i is assumed, tentatively supposed to measure the individual chances of each person missing a particular error. Two probabilities are computed (1) that as a group the m readers will discover N and miss n of the $N + n$ errors, and called P(A), and (2) that if event A occurs, the findings of the readers would be distributed in such a manner less likely than that observed and called P(B). With these probabilities known as functions of $[p_i]$, that set $[p_i]$ is sought which makes P(A) as large as possible (say $\overline{M}$) subject to the limitation that P_A (B) shall not fall below a preassigned magnitude $\underline{M}$. Then it can be asserted that if there are n undiscovered errors, no possible assumption regarding $[p_i]$ can make the probability of the event A exceed $\overline{M}$, without at the same time making the probability of event B less than $\underline{M}$. R. S. R.

1523. Calculation of Errors. L. T. DeVore. *Phys. Rev.* 51. *pp.* 349–354, *March* 1, 1937.—An exact analysis is developed for the calculation of erratic experimental errors. Methods of calculation which have been used are examined and criticised. The analysis is applied to the specific case of the determination of erratic errors resulting from disturbances in a galvanometer system. The formulæ obtained reduce, in a second approximation, to those obtained by Zernicke. It is shown that these approximate formulæ are too inexact to be used in cases in which the number of observations is small. The exact formulæ and more accurate approximations are worked out in detail. AUTHOR.

1524. Principles Involved in Determining the Absolute Values of the Electrical Units. H. L. Curtis. *Am. Phys. Teacher*, 5. *pp.* 7–14, *Feb.*, 1937.—The author outlines the principles underlying the establishment of the electrical units in the c.g.s. electromagnetic system, and indicates the method by which these units are now maintained in the national laboratories. P. V.

See also Abstracts 1499, 1503, 1539, 1561, 1717.

MECHANICS, CLASSICAL.

1525. Conservation of Energy and Momentum in Elementary Processes. A. N. May. *Phys. Soc., Reports*, 3. *pp.* 89–105, 1936.—Progress review.

1526. Dynamics of a Deformable Body of Variable Mass. G. Arrighi. *Accad. Lincei, Atti.* 24. *pp.* 264–267, *Nov.*1, 1936.—The author refers to De Marchi's treatment of the propagation of waves in which he makes use of a particular extension of the equation of continuity in deformable bodies of variable mass, and also mentions his own general treatment of this problem. In the present paper he develops an indefinite equation of dynamical equilibriums and the relative theorem of *vis viva*. J. J. S.

1527. Motion of a Compressible Fluid of Variable Mass with Forces Derived from a Potential. G. Arrighi. *Accad. Lincei, Atti.* 24. *pp.* 268–272, *Nov.* 1, 1936.—The author gives a mathematical treatment of the problem taking the indefinite equation of dynamical equilibrium relative to a body of variable and deformable mass subjected to forces of amount $\rho F d\tau$ accelerating the element of volume $d\tau$, and calling p the specific pressure and a the variation of mass ($\gtrless 0$ either increase or decrease) relative to the unit of volume and unit of time, an Eulerian expression is found. J. J. S.

***1528. Photoelectric Measurement of Projectile Velocities. D. C. Rose.** *Canad. J. of Research*, 15. *Sect. A. pp.* 1–14, *Jan.*, 1937.—An outline of the method in which the projectile interrupts successively beams of light shining on photo-cells placed along the trajectory is given. The velocity is measured by means of records taken of the times between interruptions of the beams of light. An area about 24 by 30 in. is made sensitive to the projectile by reflecting a beam of light across this area several times, then directing it on the photo-cell. The details of the apparatus are given. The recording apparatus consists of an amplifier which impresses the current pulse from the photo-cell on the grid of a thyratron when the projectile interrupts the light beam. This thyratron, on discharging a condenser, emits a short flash of light which is recorded on a rotating drum camera. A similar thyratron controlled by a tuning fork puts a simultaneous time record on the film. The camera is so designed that the film can be taken out and developed in daylight. The results of firing tests in Petawawa indicate that the apparatus can be used successfully in daylight with field guns. The present equipment measures velocities with a probable error of less than 2 ft. per sec. for muzzle velocities of the order of 1600 ft. per sec. Improvements in design are discussed. AUTHOR.

***1529. Electrically Driven Ultracentrifuge. J. W. Beams and L. B. Snoddy.** *Science*, 85. *pp.* 185–186, *Feb.* 12, 1937.—An electrical drive is described to take the place of the air turbine previously described, and so make unnecessary the somewhat large air compressor required for this. The rotation frequency thus attained is practically equal to that of the a.c. used, and as constant as it is, though for the very highest speeds the air turbine is necessary. [See Abstract 4478 (1935)]. C. A. S.

See also Abstracts 1544, 1560, 1813.

MECHANICS, QUANTUM.

1530. Coulomb Wave-Functions in Repulsive Fields. E. R. Wicher. *Terr. Mag.* 41. *pp.* 389–392, *Dec.*, 1936.—The calculations of Yost, Wheeler, and Breit [see Abstract 1047 (1936)] for the solution of the radial equation in inverse-square repulsive fields are extended to the case L = 2. AUTHOR.

1531. Dirac Electron Equations in General Relativity. H. Yamamoto. *Japanese Journ. Phys.* 11. *pp.* 35–66, *Dec.*, 1936. *In English.*—A covariant formulation of a system of equations of the first order is obtained by the method of usual tensor analysis of four dimensional manifold, without making use of any auxiliary spaces or quantities. It is shown that this system of equations can naturally be regarded as a possible generalisation of Dirac's wave equation for an electron. A scheme of a world geometry is developed, which is intended to be descriptive of the physical world consisting of space, time and electron. AUTHOR.

1532. Dirac's Generalised Wave Equations. S. Sakata and H. Yukawa. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 91–95, *Jan.*, 1937. *In English.*—A few elementary results of Dirac's relativistic theory of the particle with the spin larger than 1/2 are deduced, *viz.* the expressions for the velocity, the current density, the spin angular momentum and the electric and magnetic moments, which had not been given explicitly in Dirac's paper. It is noticeable that the spin and the magnetic moment are not proportional to each other in general. The invariance of the wave equations under reflection (*Spiegelung*) is also discussed. AUTHORS.

1533. Projective Wave Geometry and de Sitter's Space. H. Takeno. *Hirosima Journ. Sci.* 7. *pp.* 39–48, *Jan.*, 1937. *In English.*—Some corrections and additions are given to the previously reported development of a scheme of projective geometry [see Abstract 2556 (1936)]. The general condition for complete integrability of the fundamental equation for ψ is amplified. A more stringent fundamental equation for a completely empty universe, and its solution in the form of de Sitter's line element, are examined. Finally de Sitter's element is obtained in Robertson's form, and some other solutions of the original equation are deduced. [See following Abstract]. N. M. B.

1534. Wave Geometry Including Schwarzschild's and de Sitter's Solution. K. Morinaga. *Hirosima Journ. Sci.* 7. *pp.* 49–62, *Jan.*, 1937. *In English.*—In the wave geometry previously developed [see Abstract 4485 (1935)], the solutions of the equation for integrability of the fundamental equation for ψ were complex in space-time coordinates and did not include Schwarzschild's solution although they satisfied Einstein's gravitational law. In this paper the wave geometry of four-dimensional space is extended with the help of a number of new assumptions specialising the general case previously examined, and by the condition for the integrability of the fundamental equation it is shown that Schwarzschild's solution and de Sitter's solution, as found by Takeno [see preceding Abstract], are included in the solutions, to an approximation sufficient to interpret the results of observations. N. M. B.

1535. Conformal Wave Geometry. T. Hosokawa. *Hirosima Journ. Sci.* 7. *pp.* 63–72, *Jan.*, 1937. *In English.*—A geometry is constructed by applying the principle of linearisation [see Abstract 1985 (1935)] to generalised four-dimensional conformal geometry. An equation is derived for ψ, which, if completely integrable, determines that the four-dimensional Riemannian space based upon a metric g_{ij} can be mapped conformally on a flat space. The required conditions are found, and from the Morinaga equation [see Abstract 4485 (1935)] the g_{ij}'s are obtained; hence the conformal wave connection is given by the equations derived in the investigation. N. M. B.

1536. Spin Transformations. K. Morinaga and T. Sibata. *Hirosima Journ. Sci.* 7. *pp.* 73–80, *Jan.*, 1937. *In English.*—In general spinor calculus in non-Minkowskian space a correspondence between vector and spin transformations is sought such that it is isomorphic and that to the rotations in vector space correspond decomposed unimodular spin transformations. The case in which the metric of vector space is given by $g_{ij} = \delta_{ij}$ [see Abstract 4485 (1935)], and the case in which it is general are considered. It is concluded that the spin transformations in vector space can be regarded as independent of vector transformations, and that these spin transformations seem to be some operators corresponding to certain physical quantities, probably electromagnetism. N. M. B.

1537. Geometrisation of the Law of Physics. Y. Mimura. *Hirosima Journ. Sci.* 7. *pp.* 81–86, *Jan.*, 1937. *In English.*—This paper shows the extent to which the method of the new field theory [see Abstract 4485 (1935)] provides a possibility of the geometrisation of the law of physics. In attempting to formulate a unified field theory there is no general principle to determine on what geometry the generalisation of physical phenomena should be based. The generalised Hamilton's principle in the unified field theory plays the same rôle as the quantum condition plays in the old quantum theory, indicating that the method adopted by the hitherto proposed field theories is deficient in so far as the theory depends on the Hamilton's principle. In the new field theory this principle is replaced by the condition of complete integrability of the fundamental equation which is deduced by purely geometrical means, hence both gravitational potential and the law of gravitation are geometrised. N. M. B.

1538. Spherical Symmetry of Self-Consistent Atomic Fields. A. F. Stevenson. *Phys. Rev.* 51. *pp.* 285–287, *Feb.* 15, 1937.—An attempt is made to take account of the dependence of the wave function for each individual electron on direction, but it is shown that this does not lead to an increase in accuracy in the method of the self-consistent field. R. P.

1539. Theory of Spherical Waves. A. Erdélyi. *Physica,* 4. *pp.* 107–120, *Feb.*, 1937. *In German.*—Some properties of the solution of the wave equation for spherical waves, in terms of associated Legendre functions, are worked out. G. C. McV.

1540. Passage of Particles through Potential Barriers. A. Datzeff. *Comptes Rendus,* 204. *pp.* 558–560, *Feb.* 22, 1937.—The problem can be approximately solved if a difference equation is substituted for the differential equation. R. P.

1541. Reversibility in Quantum Electrodynamics. S. Watanabe. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 677. *pp.* 109–120, *Feb.*, 1937. *In English.*—The reversibility in time of the equations of electrodynamics is demonstrated treating the field and the particles in it as a single system. G. C. McV.

1542. Statistical Statements in Quantum Mechanics. W. Holzapfel. *Zeits. f. Physik,* 104. 5–6. *pp.* 357–380, 1937.—The author discusses and defines the meanings to be attached to probable values in quantum mechanics. G. C. McV.

See also Abstracts 1405, 1499, 1525, 1561, 1640, 1814.

RELATIVITY AND ETHER.

1543. Mixed Tensor T_{μ}^{ν}. V. V. Narlikar. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 32–33, *Jan.*, 1937.—Two new theorems of relativistic interest regarding T_{μ}^{ν} are given. AUTHOR.

1544. Born's Electrodynamics in Complex Form. P. Weiss. *Cambridge Phil. Soc., Proc.* 33. *pp.* 79–93, *Jan.*, 1937.—In this purely mathematical paper the author deals with the classical aspect of Born's theory and first develops, as generally and symmetrically as possible, all relations between the field quantities (antisymmetrical tensors) and invariants (the Lagrangian or Hamiltonian functions of which characterise the system), and some new quantities and relations are obtained. A complex formalism is then introduced which enables all these relations to be stated and proved in a simpler and shorter form. The general result is that each field theory can be described by one analytic function, the complex Lagrangian or Hamiltonian, of one complex variable. The study of Born's electrodynamics is thus largely reduced to the study of a certain class of analytic functions. N. M. B.

1545. New Field Theory. Part II.—Quantum Theory of Field and Charges. M. H. L. Pryce. *Roy. Soc., Proc.* 159*A*. *pp.* 355–382, *April* 1, 1937.—This paper deals with the quantum theory corresponding to the classical treatment of the dynamics of charged particles in the new field theory given in a previous paper [see Abstract 3498 (1936)]. It is found that new variables π_n, which played no part in the classical theory, have to be introduced. They are analogous to $p - e\mathbf{A}/c$ in the Pauli-Heisenberg theory, and appear as additive terms in the total momentum. Correspondingly, new terms W_n are necessary in the Hamiltonian. Simplicity of relativity transformation requires that W_n be a linear combination of the components of π_n. The coefficients α_n are anticommuting quantities of unit square; this is proved to be necessary for relativistic invariance. Only three α's occur, instead of the four of Dirac's theory. Using the property of momentum and energy as space- and time-displacement operators, the field equations of the new field theory follow, together with the dynamical equations for the charges. The charges each have a spin angular momentum $\pm \frac{1}{2}h$, without which the total angular momentum of the system is not constant. The transformation of the quantum variables under Lorentz's transformation of the frame of reference is derived from the study of the observables associated with infinitesimal Lorentz transformations, analogous to the angular momentum (which is associated with the infinitesimal rotations in space). In § 10 of the original it is shown that the charges, although at any instant they have the velocity of light, oscillate boundedly about a mean orbit which is described with velocity p/W.

See also Abstracts 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1560, 1561.

SOLUTION.

1546. Solubility of Gases and Krypton. F. Körösy. *Faraday Soc., Trans.* 33. *pp.* 416–425, *March*, 1937.—The empirical formula $\log \gamma_M = A + B \cdot T_k$ gives a very good approximation for the solubility of different gases in one solvent. The value of B varies but little from solvent to solvent; its constancy would indicate the validity of Just's law. The temperature coefficient of solubility at constant pressure is positive for gases with T_k under 180° K., and negative for those with T_k above 180° K. The only solvent that does not agree with this rule is water. The temperature coefficient of solubility at constant volume is always negative. The solubility of Kr is determined at room-temperature in 16 solvents with an approximate maximal error of ± 5 %. AUTHOR.

1547. Metallic State: Absorption of Deuterium in Palladium. A. R. Ubbelohde. *Roy. Soc., Proc.* 159*A*. *pp.* 295–313, *March* 15, 1937.—Dissolved H is present as atoms, partly dissociated into protons and electrons, and may therefore be regarded as metallic. Pd forms α and β solid solutions, probably interstitial, containg 0·03 % and 0·08 % H, with the same structure and in equilibrium, the solubility being proportional to $\sqrt{\text{pressure}}$. This is connected with the fact that heat of solution depends on the electron levels vacant. Lattice expansions at 20° C. for the α and β phases are 0·0041 and 0·1430 Å for H, and 0·0028 and 0·1325 for D, indicating a difference in expansion pressure of 7–8 %. Simultaneously heat of solution increases over a certain range of lattice parameters, probably because the vacant levels are lowered in energy. A similar explanation is suggested for abnormally low *thermal* expansion in the Fe-Ni alloys invar and elinvar, since both Fe and Ni are transition elements. Attempts to determine the Pd-D β boundary by an electrical resistance method failed, owing to hysteresis, but the solubility and effect on resistivity of D are both greater than in the case of H. Ionisation of dissolved H does not exceed 90 % and for D it is probably somewhat less. A modified phase-rule is suggested to explain the well-known hysteresis effects in both series of alloys. For Pd-H they seem to be due partly to strain and partly to some ordering phenomenon. D. R. H.

See also Abstracts 1417, 1811.

SURFACE TENSION AND COHESION.

1548. Surface Tension of Debye-Hückel Electrolytes. K. Ariyama. *Chem. Soc. Japan, Bull.* 12. *pp.* 32–37, *Jan.*, 1937.—A theory of surface tension of Debye-Hückel electrolytes is proposed. An explicit formula is derived and compared with experiment satisfactorily. A qualitative explanation of the Heydweiller effect is given. Interfacial tension is also discussed very briefly. AUTHOR.

1549. Surface Tension of Ternary Solutions. K. Ariyama. *Chem. Soc. Japan, Bull.* 12. *pp.* 38–43, *Jan.*, 1937.—The surface-tension theories of Debye-Hückel electrolytes can be divided into two main groups, one which is based on the assumption of the existence of the "image force" near the boundary between water and air, and the other based on the calculation of surface free energy caused by the electrostatic force of ions. On the basis of experimental evidence on the surface tension of ternary solutions, the theories of the former category are shown to be unacceptable. The theories of Oka and of the author, which belong to the latter category, are applied to explain the surface tension of ternary solutions. Agreement with experiment is satisfactory. [See Abstract 1 (1937).] AUTHOR.

1550. **Macleod's Equation for Surface Tension, and the Parachor. R. H. Fowler.** *Roy. Soc., Proc.* 159*A*. *pp.* 229–246, *March* 15, 1937.—In this paper Macleod's equation for the surface tension of a pure liquid in contact with its own vapour is considered theoretically. It is shown that Macleod's equation follows from very general assumptions for the neighbourhood of the critical temperature. The value of the parachor can therefore be computed (for a simple liquid such as A or Hg) in terms of the sizes and force constants of the atoms and the law of grouping of neighbours in the liquid, and the properties of the liquid near its critical point, all of which may be assumed to be known from other sources. The value is so computed in this paper for A and Hg in very fair agreement with the observed values. The theory, however, gives no ground for expecting that Macleod's equation should hold good over fairly wide ranges of temperature, and the fact that it usually does so appears to be due to the cancellation of a number of subsidiary effects, which enter when T is not near T_c but have not been computed exactly. AUTHOR.

1551. **General Physics: Surface Tension. R. C. Brown. Elasticity. H. L. Cox and D. G. Sopwith. Viscosity. G. Barr.** *Phys. Soc., Reports,* 3. *pp.* 1–25, 1936.—Progress review.

1552. **Effect of Dilute Hydrochloric Acid on the Surface Tensions of Aqueous Salt Solutions. J. W. Belton.** *Faraday Soc., Trans.* 32. *pp.* 1717–1721, *Dec.*, 1936.—The surface tensions of aqueous solutions of LiCl, $CaCl_2$, $SrCl_2$, $BaCl_2$, sodium perchlorate and sodium dithionate, and of ternary solutions of these salts and $0\cdot1M$ HCl are measured by the maximum bubble pressure method. The presence of the acid produces a lowering of the surface tension, the effect increasing with increasing salt concentration. The amount of water adsorbed at the surface of the ternary solutions is calculated from the Gibbs equation. AUTHOR.

1553. **Surface Tensions of N-Chloroacetanilide-Salt-Water Mixtures. J. W. Belton.** *Faraday Soc., Trans.* 33. *pp.* 440–448, *March*, 1937.—The effect of the presence of N-chloroacetanilide on the surface tension of various salt solutions has been examined. In all cases the surface tension was lowered, and in the case of the alkali chlorides a linear relation between the surface tension increment and the salt concentration was found. In order to avoid difficulties in the calculation of the amount of water adsorbed by means of the Gibbs equation, measurements were made in solutions containing the non-electrolyte at constant activity. For the alkali chloride solutions the adsorption-salt concentration curve is nearly parallel to that for solutions containing salt alone; for the alkaline earth chlorides the water adsorption falls, while that for the salt alone falls more rapidly with increasing salt concentration. The adsorption of water at the surface of a solution containing N-chloroacetanilide at constant concentration has also been calculated; the adsorption of water on the ternary solution is found to fall more rapidly with increasing salt concentration than for the binary. It is also shown that the presence of sucrose produces a reduction in the water adsorption. The adsorption of N-chloroacetanilide at the surface of the ternary solutions has been calculated and the structure of the surface layer discussed. AUTHOR.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstracts 1561, 1851.

VISCOSITY, FRICTION AND LUBRICATION.

1554. Viscosity of Mixed Salt Solutions. T. Ishikawa. *Chem. Soc. Japan, Bull.* 12. *pp.* 16–24, *Jan.*, 1937. *In English.*—The author applies a formula previously derived for binary mixtures of non-reacting liquids [see Abstract 2048 (1936)] to published data for binary mixtures of non-reacting solutions (in water), the concentrations having been maintained constant during admixture. The formula applies well to the systems urethane-urea, $ZnSO_4 - K_2SO_4$, $HCl - KCl$, $KCl - NaCl$, $HCl - NaCl$; in the last three cases the formula applies more closely than five others suggested by other workers and in the cases of $C_2H_5OH - i\text{-}C_3H_7OH$ and $C_2H_4Br_2 - C_2H_4Cl_2$ is better than fourteen others. L. V. C.

1555. Indian Vegetable Oils. Part III. G. N. Bhattacharyya. *Indian Journ. Phys.* 10. *pp.* 403–411, *Dec.*, 1936.—In continuation of Part I [see Abstract 3516 (1936)] the viscosity and its variation with temperature within the range 75° F. to 200° F. of six more Indian vegetable oils, *viz.*, Groundnut, Chaulmoogra, Neem, Kapok, Punnag and Mahua, have been determined with a standard Redwood viscometer No. 1. The viscosity within this range of temperature is found to be capable of being represented by a logarithmic formula of the form $\log \eta = \log A - \alpha t + \beta t^2 - \gamma t^3 + \delta t^4$ involving five constants, *viz.*, $\log A$, α, β, γ and δ, whose values have been evaluated. The observed values of viscosity at different temperatures are in good agreement with their calculated values from the above logarithmic formula. [For Part II see Abstract 4841 (1936).] AUTHOR.

1556. Viscosity of Vinyl Acetate. D. O. White and A. C. Cuthbertson. *Canadian J. of Research*, 15. *Sect. B. pp.* 7–12, *Jan.*, 1937.—The viscosity of monomeric vinyl acetate is measured over a range of temperatures from 0° to 60° C. Two equations were obtained which represent the results. The empirical equation is $\eta = 1{\cdot}521/(90 + t)^{1{\cdot}25}$, and a theoretical equation is given as $\eta(v)^{1/3} = 470 \times 10^{-6}\, e^{702/vT}$. The characteristic frequency is obtained from the relation $Nh\nu = RT/(1/\mu - 1)$, where μ is the ratio between the latent heat of evaporation and the heat of cohesion. ν is found to be $2{\cdot}17 \times 10^{12}$. AUTHORS.

***1557. Determination of the Viscosity of Air. G. Kellström.** *Phil. Mag.* 23. *pp.* 313–338, *March*, 1937.—The apparatus used for this redetermination of the viscosity of air by the rotating cylinder method is illustrated and described in detail. It has been designed with considerable care and every precaution has been taken to eliminate accidental errors, two different outer cylinders and several different suspensions for the inner cylinder being used. Of 54 determinations the extreme values, corrected to a temperature of 20° C., are $18{,}163 \times 10^{-8}$ and $18{,}234 \times 10^{-8}$ e.s.u. After analysis of the results and allowance for systematic errors the final value obtained is $\eta_{20} = (18{,}201 \pm 27)\, 10^{-8}$ e.s.u. Millikan, in 1916, when deriving his value for the electronic charge of $e = 4{\cdot}774 \times 10^{-10}$ e.s.u., used the value $\eta_{23} = 18{,}226 \times 10^{-8}$ as determined by Harrington. The present results indicate that $\eta_{23} = (18{,}349 \pm 27)\, 10^{-8}$, and this combined with Millikan's original data, gives $e = (4{\cdot}818 \pm 0{\cdot}011)\, 10^{-10}$ e.s.u. Absolute wave-length measurements of X-rays yield $e = 4{\cdot}805 \times 10^{-10}$, and it now seems that Millikan's lower value resulted from the use of too low a value for the viscosity of air. R. W. P.

See also Abstracts 1424, 1495, 1551.

ASTRONOMY AND ASTROPHYSICS.

COSMOGONY.

1558. Cosmological Constants. P. A. M. Dirac. *Nature*, 139. *p*. 323, *Feb*. 20, 1937.—By expressing the age of the universe as derived from cosmological theories (2×10^9 years) in units provided by the atomic constants (e^2/mc^3), the author obtains a number comparable with the ratio of the electric to the gravitational force between the electron and the proton (10^{39}). He suggests that this ratio, and also that between the mass of the universe and the mass of the proton (10^{78}) are functions of the age of the universe. This leads to the supposition that the amount of matter in the universe is constantly increasing while the gravitational "constant" decreases. He introduces a new time variable ($\tau = \log t$) similar to Milne's distinction between "dynamic" time as measured by pendulums, etc., and "kinematic" time measured by radioactive and atomic phenomena. [See following Abstract.]

1559. Constant of Gravitation. E. A. Milne. *Nature*, 139. *p*. 409, *March* 6, 1937.—The author relates considerations recently advanced by Dirac [see preceding Abstract] with his own results, but concludes that there is no inference as to the creation of matter. The form of the differential relation connecting intervals for the $t \rightarrow \tau$ transformation is stated.

1560. Kinematics, Dynamics and the Scale of Time. Part II. E. A. Milne. *Roy. Soc., Proc.* 159*A*. *pp*. 171–191, *March* 15, 1937.—In a previous paper [see Abstract 554 (1937)] it was shown that when clocks reading kinematic time t are re-graduated to read a certain new time-measure τ, those terms in the *local* equations of motion of a particle which represent the general gravitational field of the universe are transformed away, leaving equations purely Newtonian in form. In the present paper the corresponding relativistic treatment is given. In agreement with other workers who have treated the kinematic aspects, it is shown that the time τ is an invariant, affording a world-wide Newtonian time; and that while the "private" spaces of the fundamental observers are arbitrary the most convenient "public" space to adopt with τ-time is a static hyperbolic space, locally Euclidean. Dynamically it is shown that the energy of a particle is given by Einstein's formula, provided this is evaluated in τ-time and hyperbolic space; and the principle of inertia for a free particle is derived *a priori*. All exact relations in τ-measures contain explicit mention of the present age t_0 of the universe, but this disappears in local approximations. A variational principle is derived, and the transformation of the Lorentz formulæ to τ-measures is carried out. The relation of general relativistic cosmology to the present results is examined. AUTHOR.

1561. Ultimate Measurements of Space and Time. H. T. Flint. *Roy. Soc., Proc.* 159*A*. *pp*. 45–56, *March* 2, 1937.—Certain conclusions with regard to fundamental units of length and time are drawn from a derivation of the quantum equation [see Abstracts 1183, 1184 (1928)]. The units of length h/m_0c and e^2/m_0c^2 are shown in relation to one another, the former being characteristic of regions where the electromagnetic field is absent or very weak, the latter appearing to modify the principle of least proper time where charges occur. It is also shown that with a choice of units suggested by Born the fundamental constant of the theory proposed is the ratio, e^2/hc, of these lengths. The argument is based upon a modification in Weyl's form of the change of length in a parallel displacement, which is supplemented by a principle leading to the result that lengths are transferable in the physical world without ambiguity. While the interpretation of gravitational and electromagnetic phenomena is substantially the same as in the theory of Einstein and of Weyl and Eddington, the quantum theory is interpreted as providing physics with a means of avoiding ambiguity relating to length and time measurements. AUTHOR.

See also Abstract 1627.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1562. Solution of a Set of Differential Equations in the Theory of Saturn's Rings. C. G. Pendse. *Phil. Mag.*, **23.** *pp.* **425–440,** *March*, **1937.**

NEBULÆ.

1563. Effect of Red-Shift on Magnitudes of Nebulæ. A. S. Eddington. *Roy. Astron. Soc., M.N.* **97.** *pp.* **156–163,** *Jan.*, **1937.**—On the hypothesis of uniform distribution, Hubble [see Abstracts **5036** (1936) and **122** (1937)] has deduced from counts of faint nebulæ that the effect of red-shift on magnitude is $\Delta m = 2{\cdot}94 d\lambda/\lambda$. The theoretical effect is $\Delta m = 4{\cdot}0 d\lambda/\lambda$ if the red-shift is due to recession, or $3{\cdot}0 d\lambda/\lambda$ if it is due to other suggested causes. In deriving the coefficient 2·94, the dispersion of the absolute magnitudes of the nebulæ was neglected. Formulæ are here developed which take account of the dispersion. By including the dispersion the observational result is changed to $\Delta m = 3{\cdot}06 d\lambda/\lambda$. The correction thus proves to be unimportant. It is pointed out, however, that (taking into account only one recognised source of accidental error) the probable error of k is 0·56; so that the difference from the expected value 4·0 is scarcely sufficient to constitute a discordance. AUTHOR.

1564. Distribution of Extra-Galactic Nebulæ. G. C. McVittie. *Roy. Astron. Soc., M.N.* **97.** *pp.* **163–167,** *Jan.*, **1937.**—The nebular counts are in agreement with an infinite universe of negative curvature whose radius is of the order of 10^9 light years. The average density of matter is of the order of 10^{-32} gm./cm.^{3}, the cosmical constant has the negative value -21×10^{-34} sec.$^{-2}$ and the expansion is being retarded. Hubble's observations [see Abstracts **5036** (1936) and **122** (1937)], however, suggest a maximum value of 0·77, instead of the value 0·507, for the constant term in the relation between velocity and apparent magnitude uncorrected for red-shift, which is alone appropriate for a comparison of theory and observation. With this value of the constant the present method yields $\dot{R}_0/R_0 = 3{\cdot}42 \times 10^{-17}$ sec.$^{-2}$; $\ddot{R}_0/R_0 = -3{\cdot}96 \times 10^{-34}$ sec.$^{-2}$; $\rho = 1{\cdot}04 \times 10^{-32}$ gm./cm.^{3}; $k = -1$; $R_0 = 6{\cdot}16 \times 10^8$ lt. yrs.; $\Lambda = -12 \times 10^{-34}$ sec.$^{-2}$; in good agreement with the previous results. AUTHOR.

See also Abstract 1641.

PLANETS.

1565. Photoelectric Photometry of Planetary Surfaces. M. Maggini. *Accad. Lincei, Atti,* **24.** *pp.* **278–282,** *Nov.* **1, 1936.**—Two balanced photoelectric cells are arranged so that one of them may be influenced by a planetary image. The northern and southern bands of Jupiter are examined and detailed observations are made on Saturn and its rings. F. C. C.

See also Abstract 1562.

STARS.

1566. Orbit of Σ 2026. R. v. d. R. Woolley and L. S. T. Symms. *Roy. Astron. Soc., M.N.* 97. *pp.* 168–173, *Jan.*, 1937.

1567. Proper Motions of Faint Stars in Two Regions. Violet F. White. *Roy. Astron. Soc., M.N.* 97. *pp.* 202–207, *Jan.*, 1937.

1568. Dimensions of Nova Herculis. A. Beer. *Roy. Astron. Soc., M.N.* 97. *pp.* 231–245, *Jan.*, 1937.—The attempt to combine temperature T, brightness m and absorption line radial velocities V, as observed in some Novæ in the phase before maximum, leads to fundamental discrepancies. The introduction of two active surfaces s and S with the radii r and R is put forward as a tentative suggestion, which removes the difficulties—the expansion of the one being responsible for the changes in T and m, the expansion of the other for the observed V curve. Equations for the rate of increase of r and R are derived and the results for different assumed initial conditions are given. The most probable assumptions lead to a date of the outburst of Nova Herculis 1934 of December 11·34, $1^{d}\cdot85$ before discovery. If three-quarters of the way through this first development, from outburst to the first observation, the outer active surface S was cast off from the inner s (the expansion velocities and the radii of both surfaces being then identical), we find for the radius of the inner " star " at the time of discovery 21 ⊙, and for the distance of the second active surface from this inner one: 77 ⊙ for hydrogen, and 48 ⊙ for FeII etc. With these initial values the quantities r and R are represented as functions of time. It is, at a time shortly before light maximum (for the initial quantities just given), $r = 156$ ⊙; R = 561 ⊙ for hydrogen and 399 ⊙ for FeII etc. The behaviour of the different atoms is discussed with regard to possible pictures of the Nova outburst. AUTHOR.

1569. Doubling of Nebular Lines in Spectrum of Nova Herculis, 1934. D. Belorizky. *Comptes Rendus*, 204. *pp.* 413–414, *Feb.* 8, 1937.—All visual lines are weak except N_1 (5007 Å), N_2 (4959 Å) and the order of strength is N_1, N_2, 4363 and then H lines. Since Oct., 1936, N_1 and N_2 are doubled, but not 4363 (though all are forbidden O III lines) nor the H lines. The author concludes that N_1 and N_2 come from the nebula formed by the gas issuing from the star which rotates at not less than 220 km./sec., but that 4363 and the H lines come from the inner layers. A. S. D. M.

See also Abstracts 1617, 1627, 1655.

SUN.

1570. Intensity Observations of Solar Corona during Eclipse of 19 June, 1936. M. de Saussure. *Arch. des Sciences*, 18. *pp.* 282–291, *Nov.–Dec.*, 1936.—The paper presents preliminary results from the Observatory of Vienna expedition to C. Sounion, 30 mls. S.E. of Athens. Meteorological conditions were excellent. During the 69 sec. of totality, 2 direct exposures of 1 sec. and 10 sec. respectively were made to the corona on hypersensitive orthochromatic plates in a camera of 50-mm. aperture and 605-mm. focal length mounted on a moving equatorial. Intensity calibration of the plates was carried out subsequently, the relevant conditions being approximately the same as during the eclipse. Four out-of-focus images of α Aurigæ were recorded on the plates with exposure times in geometrical progression, the corresponding intensity range calculated from the Schwarzschild law covering 3·2 magnitudes. The observed decrease of luminosity of the corona on passing radially outward from the sun is compared with that given by several previously proposed formulæ. In the region explored, between 3′ and 16′ from the limb, the best fit is given by Turner's expression, in which the intensity is inversely proportional to the 6th power of the radial distance from the sun's centre. A. Hu.

1571. Presence of Molecular Hydrogen in Sunspots. G. Piccardi. *Accad. Lincei, Atti.* **24.** *pp.* **212–215,** *Oct., and pp.* **286–288,** *Nov.* **1, 1936.**—The author shows that there can be no doubt from the point of view of chemical physics that molecular H_2 exists in sunspots, and gives a review of the researches of recent years which by means of spectroscopy have led to the identification of the molecule H_2 in sunspots. In the spectroscopic study of the sun, there still exist many anomalies which have not yet received any explanation. J. J. S.

1572. Evaluation of Ultra-Violet Solar Radiation in Absolute Units. W. W. Coblentz. *Monthly Weather Rev.* **64.** *pp.* **319–421,** *Oct.,* **1936.**—Recently the standardisation in absolute units of u.v. radiometers has been discussed by the author and his remarks are now elaborated. A definite wave-length has a specific effect in healing rickets and this particular wave-length of 3132 Å and shorter wave-lengths are suggested for inclusion in meteorological reports of solar radiation. The author, in collaboration, has worked out two methods of measurements in absolute units, for artificial sources of u.v. radiation and from sunlight, as utilised in medicine. The method is also of use to meteorologists. The first method employs a differential thermopile and filters and requires knowledge of transmission *via* the filters and distribution of energy adjacent to the band of radiation investigated. The second method employs a Ti- or Cd-photo-cell and glass filters in Wheatsone-bridge connection with a balanced amplifier and a microammeter. This method permits simultaneous determination of spectral quality and total intensity. Examples of use and a Bibliography are given. B. J. L.

See also Abstracts 1625, 1626.

GEOPHYSICS.

GEODESY.

1573. Geodetic Surveying for Map Production. E. B. Lockett. *Junior Inst. Eng., J.* 47. *pp.* 205–237, *March,* 1937.—A practical account of the methods of taking and applying the necessary terrestrial and astronomical observations, without abstruse mathematics; with some account of the methods of projection. C. A. S.

GEOPHYSICS, APPLIED.

***1574. Testing Reflection Seismographs. J. H. Jones.** *Inst. Petroleum Technologists, J.* 23. *pp.* 26–31; *Disc.,* 34–39, *Jan.,* 1937.—Seismographs were set out in line, and a shot was fired from a point in the same line. Later records were taken of a shot fired at a distant point on a line at right angles to the above. Comparison of the records enabled the characteristics of reflected waves to be disentangled from those of refracted waves. W. A. R.

1575. Seismic Surveying. R. Davies. *Inst. Petroleum Technologists, J.* 23. *pp.* 31–34; *Disc.,* 34–39, *Jan.,* 1937.—The method of reversed refraction arcs was used in difficult country by first obtaining observations with an arc located over a known section. W. A. R.

LAND, PHYSICS OF THE.

***1576. Meter for Recording Slow Liquid Flow. J. O. Ivie and L. A. Richards.** *Rev. Sci. Instruments,* 8. *pp.* 86–89, *March,* 1937.—A description is given of a reversible flow meter designed to work as part of a soil moisture flow gauge. The flow is measured by forming drops of water in a less dense non-miscible liquid and electrically recording the drops. The operating characteristics are discussed and an empirical equation giving the effect of temperature and flow rate on drop size is derived. AUTHORS.

METEOROLOGY.

1577. Upper Atmosphere. §§1 to 11. S. Chapman. §§12 to 16. S. Chapman and W. C. Price. *Phys. Soc., Reports,* 3. *pp.* 42–65, 1936. Progress review.

1578. Physical State of the Upper Atmosphere. B. Haurwitz. *Roy. Astron. Soc., Canada, J.* 31. *pp.* 19–42, *Jan., and pp.* 76–92, *Feb.,* 1937.—This continues previous work [see Abstract 936 (1937)]. The author first discusses atmospheric ozone, its absorbing power for solar radiation, its total amount, its annual variation and its geographical and vertical distributions. Its great absorbing power is seen to determine to a large extent the temperature of the upper atmosphere. The theory of its origin mainly considered is that of Chapman. In his next section the author deals with the anomalous propagation of sound. The varying directions of audibility in summer and winter are accounted for. The greater velocity of sound in the upper atmosphere affording an explanation of the zones of audibility, in all probability arises through the high temperatures of the upper atmosphere. In dealing with the composition of the atmosphere the author points out that this is constant owing to mixing up to heights of about 20 km. Above this mixing continues to a certain extent and diffusion equilibrium is not to be expected on theoretical grounds below 100 km. A. E. M. G.

1579. Distribution of Atmospheric Ozone. O. R. Wulf and Lola S. Deming. *Terr. Mag.* **41.** *pp.* 375–378, *Dec.*, 1936.—This continues previous work [see Abstract 4601 (1936)], the point dealt with in the present case being the influence of absorption in the visible spectrum (Chappuis bands). The absorption coefficients here vary slowly with wave-length so that fairly wide intervals with constant coefficients may be used. The calculated distribution in height of O_3 molecules is given in tabular form and is also shown by diagram. The authors find that this absorption in the Chappuis bands acts in the steady state as an important check upon any large increase in the total ozone. A. E. M. G.

1580. Constancy of CO_2 and O_2 Content of the Atmosphere. T. M. Carpenter. *Am. Chem. Soc., J.* **59.** *pp.* 358–360, *Feb.*, 1937.—Three series of samples of outdoor air consisting of 75 at Durham, New Hampshire, 790 at Baltimore and 291 at Boston were analysed for CO_2 and O_2 content by means of an apparatus on which readings are estimated to 0·001 %. Each series was scattered over nearly the same number of days as there were analyses. The grand average of all three series gave 0·031 % for CO_2 and 20·939 % for O_2. In spite of widely different local conditions of the three laboratories there was no evidence that variations in season or proximity of large consumers of fuel caused any measurable differences in CO_2 and O_2 content of atmospheric air. AUTHOR.

1581. Nocturnal Radiation from the Sky. L. A. Ramdas, B. N. Sreenivasiah and P. K. Raman. *Indian Acad. Sci., Proc.* **5A.** *pp.* 45–56, *Jan.*, 1937.—The hourly variation of the heat radiation coming from different altitudes of the night sky was measured on three nights in April and May, 1936, with a Moll's micro-galvanometer and a micro-thermopile provided with a small aperture. These observations show that the nocturnal cooling of the radiating air-layers, as shown by the decrease in the equivalent black-body temperature of the sky, is maximum for altitude zero (*i.e.*, horizontal) and minimum for altitude 90° (*i.e.*, zenith). AUTHORS.

1582. Temperature and Interchange within Earth Inversion. H. G. Koch. *Gerlands Beitr. z. Geophys.* **49.** 4. *pp.* 407–426, 1937.—By means of balloons carrying resistance thermometers the distribution of temperature to a height of about 100 m. was determined. The results are discussed in detail showing the distribution both by day and by night when the air is still or there is only a slight wind. A woody region exhibits a special climate, which is compared with that of a meadow or heath. C. A. S.

1583. New Subdivision of Tropospheric Air Masses. P. Zistler. *Naturwiss.* **25.** *pp.* 104–106, *Feb.* 12, 1937.—A table is given showing the new German classification of air masses into arctic, middle latitudes, subtropical and equatorial. Subdivisions are used according to (1) the main track, maritime or continental, and (2) the direction of flow, producing fohn, dust-laden, surface inversion, surface heating, stable and unstable effects. The equivalent potential temperature has a constant value at various heights, and is independent of vertical movement, and for each height there is a gradual seasonal change. Two main fronts are obtained in the analyses of charts, the arctic and tropical fronts, and along these the successive changes in the life history of depressions can be traced and used in forecasting. R. S. R.

1584. Atmospheric Waves. S. Suzuki and H. Oomori. *Gerlands Beitr. z. Geophys.* 49. 3. *pp.* 301–318, 1937. *In English.*—Three microbarographs placed considerable distances apart were used in this investigation carried out in 1933–34 and dealing with the velocity of propagation and the wave-length of atmospheric waves. The authors find that both a surface of discontinuity and a relative wind of sufficient strength is necessary for the production of the waves. Relations connecting wave-length with velocity of propagation, and also with height of discontinuity surface, are established. The usual types of waves observed are summarised. The velocity of propagation of such waves is nearly equal to the relative velocity of the wind above with respect to that below the surface of discontinuity. The seasonal maximum frequency occurs in the cold season, the diurnal between 8 h. and 10 h., while their generation takes place before and after the line of occlusion passes. The results of the investigation are set out in tabular form. A. E. M. G.

1585. Geometrical Theory of Haloes. Part I. E. W. Woolard. *Monthly Weather Rev.* 64. *pp.* 321–325, *Oct.*, 1936.—Distinction is drawn between haloes and coronæ. The former are due to ice crystals and arise by refraction through or reflection by the various forms of crystal. To obtain a theoretical explanation of an observed halo the author points out that it is necessary (1) to establish the fact of the existence of a certain form of ice crystal falling in a certain orientation, and (2) to identify the observed halo with one which the optical-meteor theory indicates would be produced by such. The present paper forms an introduction to a general theory which the author has developed. Here the simpler forms and their causes are discussed, a halo observed on Jan. 10th, 1918, at Boulder serving as an illustration. A. E. M. G.

1586. Mechanism of Emission of the Forbidden Lines of Neutral Atomic Oxygen by the Night Sky. A. K. Das. *Gerlands Beitr. z. Geophys.* 49. 3. *pp.* 241–251, 1937. *In English.*—In a previous paper [see Abstract 3557 (1936)] the author has outlined a tentative theory of the high temperature of the earth's outer atmopshere on the assumption that neutral atomic O, which probably forms the principal constituent of the atmosphere between the 100 km. and 200 km. levels, absorbs out of the solar and stellar radiation the forbidden lines λ 2972, λ 5577, λ 6300 and λ 6364 and attains a high equilibrium temperature at which the absorbed radiations can be re-emitted. It has been shown also that the theoretically calculated temperature and the rate of emission of the green line of the night sky agree well with the experimentally known values. In the present paper certain points which were implicit in the method of calculation employed in the previous paper have been explicitly brought out, and it has been found from quite general principles of quantum theory that on account of the special conditions of density existing in the region of the atmosphere concerned and on account of the metastability of the 1 *S* and 1 *D* states of the neutral O atom the atomic O layer should be expected to attain a thermally steady state which can be taken to be that of thermodynamical equilibrium. The emission of the forbidden OI lines by the night sky appears, according to the present theory, to be a case of fluorescence under the influence of dilute temperature radiation. AUTHOR.

✱1587. Thermal Errors of the Altitude Barometer and their Compensation. L. Elia. *Accad. Sci. Torino, Atti,* 72. *Disp.* 1a. *pp.* 76–86, *Nov.-Dec.,* 1936.—The influence of the variations of temperature on the indications of an altitude barometer is analysed, consideration being given to the differential expansions and the variations of rigidity of the elastic system; and the law with which the corresponding error varies proportionally is determined. The residual errors which occur along with these are considered. J. J. S.

See also Abstracts 1600, 1730, 1853, 1855, 1856.

SEISMOLOGY.

1588. Deep-Focus Earthquakes. C. Bois. *Comptes Rendus,* 204. *pp.* 608–610, *Feb.* 22, 1937.—The focal depths of the same 17 earthquakes [see Abstract 4619 (1936)] were calculated by means of Wadati's tables and Brunner's curves, applied to records obtained at Strasburg. The latter method gives an average depth some 25 km. (about 5 %) > the former. It is considered that results deduced by aid of Wadati's tables are the more reliable and that the hypothesis of Knott regarding velocities in the interior of the earth used by Brunner, is incorrect. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1589. Diameter of the Lightning Channel. B. F. J. Schonland. *Phil. Mag.* 23. *pp.* 503–508, *March,* 1937.—A lightning photograph is discussed which shows the first and last separate strokes of the discharge to have had their channels shifted a distance exceeding 3·7 m. by the wind. It is found that the average diameter of the lightning stroke channel is about 16 cm. The heaviest stroke gave a diameter of 23 cm. and the weakest branch one of 11 cm. Consideration is given to the question whether this diameter represents that of the electrical core of the discharge. AUTHOR.

1590. Oscillations in Magnetic Records. L. Harang. *Terr. Mag.* 41. *pp.* 329–336, *Dec.,* 1936.—These small perturbations occur in all records if the recording apparatus is sufficiently sensitive. The author, after referring to early investigations, proceeds to discuss the records obtained at Tromsö in 1929–36. The oscillations are sinusoidal with period of about 120 sec. and amplitude decreasing with increasing distance from the auroral zone. They show a diurnal maximum between 1 h. and 6 h. G.M.T. with two annual maxima about the equinoxes. For further study of these perturbations the rapid registration of earth currents was undertaken in 1934. Another set of oscillations with periods less than a second have also been observed. These like the first set are most pronounced in the vicinity of the auroral zone, with diurnal maximum between 8 h. and 10 h. G.M.T. and annual maxima near the equinoxes. A number of records are reproduced. A. E. M. G.

1591. Rapid Micropulsations at Sodankylä. E. Sucksdorff. *Terr. Mag.* 41. *pp.* 337–344, *Dec.,* 1936.—These pulsations appear in quick run records of terrestrial magnetism and earth-currents as widenings of the curves. Single oscillations, as the period of such is less than 2 or 3 sec., cannot be determined. The daily and annual distribution of these pulsations for the period 1932–35 has been investigated. The results are set out in tabular form, and are also represented diagramatically. The author concludes that the pulsations occur more frequently by day

than by night but that the time of maximum varies with the time of year. The annual distribution gives a principal maximum in Sept. with smaller maxima in Jan. and March. But more data are required before a definite statement can be made regarding the nature of these pulsations.
A. E. M. G.

1592. Austrian Jan Mayen Expedition in Polar Year, 1932/33. Part II. R. Kanitscheider. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp*. 483–494, 1936.—A report on the daily magnetic character of the three magnetic elements D, H and Z on quiet days for the three epochs polar night, transition time and polar day. There are added details of the frequency of the times of commencement of daily extremes in these elements. Graphs are given of the diurnal variations in D, H and Z for the three epochs. A maximum declination takes place between 3 and 4 a.m. followed by a longer continued but not so deep minimum in which the lowest value is reached between 13 and 14 o'clock. With increasing sun altitude the commencement of the maximum and of the minimum is delayed. Tables of the hourly values of D, H and Z from the beginning of Nov., 1932, to the end of July, 1933, are appended. [For Part I see Abstract 2652 (1936)]. G. E. A.

1593. Magnetisation of Baked Earths. É. Thellier. *Comptes Rendus*, 204. *pp*. 184–186, *Jan*. 18, 1937.—An argillaceous mass baked in a magnetic field retains, after cooling, a feeble permanent magnetisation which is very stable. The question is raised whether the terrestrial field of a given epoch can be gauged from the magnetic properties of baked earths baked during the same epoch. Values are given for the specific magnetisation of earths baked in different atmospheres at different temperatures. The following results are stated. When a magnetised baked earth is reheated in zero magnetic field, its magnetisation disappears at T = 580° C. or 670° C. During the initial baking in a magnetic field, the earth becomes magnetised only between the temperature T and ordinary temperature. The magnetisation of an earth baked at a high temperature is exactly the same when the field is applied during heating and cooling and when it acts only during cooling from 670° C. If an earth baked at a high temperature acquired a magnetisation σ in a field H, and is reheated in a neutral atmosphere to 670° C. (demagnetised), then cooled in the same field H, it assumes a new magnetisation σ', but very often $\sigma' = \sigma$. G. E. A.

1594. Terrestrial Magnetic Variations and Auroræ. E. O. Hulburt. *Rev. Modern Physics*, 9. *pp*. 44–68, *Jan*., 1937.—The rapid magnetic variations are of two types, periodic and erratic. They depend on electric currents in the atmosphere. The state of ionisation of the atmosphere, its electric and magnetic fields and air currents are therefore dealt with first. The manner in which periodic variations which are associated with solar and lunar days arise is next considered. Streams of charged particles or ultra-violet light from the sun are regarded as the probable causes of magnetic storms and auroræ, the erratic type of variation. Numerous diagrams illustrate the paper. A. E. M. G.

See also Abstracts 1578, 1855.

RADIOACTIVITY.

1595. Origin of α-Particles of 2 cm. Range. J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 145. *2a.* 6. *pp.* 449–460, 1936.—Using an apparatus sufficiently sensitive to record the emission of 2 α-particles per gm./sec., it is shown that Tm, Yb, Ir, Os, Re, W, Ta, Ba, Cd, Ag, Nb, Br emit no α-rays. In agreement with other workers, however, it is found that Sa and other rare earths appear to be associated with an element which emits α-particles of about 1·8 cm. range. It is suggested that the element of atomic number 61 is responsible; the half-value period is estimated at 10^8 yr. This result is contrary to Gamow's theory which seems also to fail with Sa. F. C. C.

1596. β-Radioactivity and Nuclear Forces. I. Tamm. *Phys. Zeits. d. Sowjetunion*, 10. 5. *pp.* 567–604, 1936. *In English.*—Modifications of Fermi's theory of β-decay are discussed, which contain as a special case the law proposed by Uhlenbeck and Konopinski. It is shown that these alternative forms lead to good agreement regarding the dependence of the decay constant on the electron energy, but that they cannot explain the forces between the heavy particles as an effect of second approximation. R. P.

1597. Continuous Spectrum of β-Rays from RaE. G. F. v. Droste. *Zeits. f. Physik*, 104. 5–6. *pp.* 335–356, 1937.—The characteristic γ-radiation of RaE, as well as the continuous spectrum excited by its β-rays in elements of different atomic number, is investigated by means of a Geiger-Müller counter. It follows from the shape of the absorption curves that the spectral distribution of the continuous radiation is independent of Z and approximately equal to that of the γ-rays of RaE. From a consideration of the sensitivity of the tube counter [see Abstract 3591 (1936)] the intensity of the continuous radiation produced from different atoms is measured and the result compared with the calculation of Bethe and Heitler. T. A. C.

1598. Ionisation by γ-Rays and Cosmic Rays in Various Gases. J. Juilfs and V. Masuch. *Zeits. f. Physik*, 104. 5–6. *pp.* 458–467, 1937.—The intensity of ionisation by radioactive γ rays and by cosmic rays is measured in the same radiation apparatus in the inert gases, H_2, air, O_2 and CO_2. Whilst in all cases the hard components of the cosmic radiation ionise proportionately to the density the intensity of ionisation by γ-rays in gases increases more than in direct proportion to the density. It is endeavoured to explain the differences between intensities of ionisation in non-inert gases of the same density as due to the influence of the recombination coefficients of the ions. J. E. K.

1599. Ionisation of Air by γ-Rays as a Function of Pressure and Collecting Field. I. S. Bowen and E. F. Cox. *Phys. Rev.* 51. *pp.* 232–234, *Feb.* 15, 1937.—The γ-ray ionisation current measurements in air at high pressures made by Erikson and by Clay and van Tijn are shown to be largely modified by volume recombination at collecting fields below about 400 V/cm. The Jaffé theory of columnar ionisation does not explain the observed variation of ion current when it is applied over a wide range of collecting fields to data free from volume recombination. AUTHORS.

See also Abstracts 1414, 1525, 1632, 1705, 1776, 1777, 1812, 1847.

RADIATION.

ABSORPTION AND TRANSMISSION.

1600. Transmission Factor of a Spectroradiometer. K. K. Kay and H. M. Barrett. *J.O.S.A.* 27. *pp.* 65–68, *Feb.*, 1937.—In connection with atmospheric pollution studies it was necessary to assay the radiant flux of a quartz Hg vapour lamp in absolute energy units in the region 2967–3024 A. A spectroscope with silica lenses and prisms having a Coblentz thermopile as detector constituted the spectroradiometer. Comparison of the intensity of a monochromatic beam, from an auxiliary spectroscope before and after transmission through the spectroradiometer gave the transmission factor for the wave-length used. The effect of stray radiation and the distance of the source from the spectroradiometer was studied, since it is essential that all radiation incident on the slit is also incident on the collimator lens. It was obtained by varying the distance of the source and comparing the intensity with that to be expected from the inverse square law. T. A. C.

See also Abstract 1427.

COLORIMETRY.

1601. Optimum Pigment Colours. H. E. J. Neugebauer. *Zeits. f. wiss. Phot.* 36. *pp.* 18–24, *Jan.*, 1937.—Extends Luther's considerations of the colour bodies for the optimum pigment colours [see Abstract 872 (1928)], in which it was shown that the ends of the vectors of the optimum colours lie on a centrally symmetrical surface, there being a simple relationship between this surface and the colour moment summation curve. Reference is made to the parallelepiped of the optimum pigments, briefly considering its use in the theory of additive colour films and multi-colour printing. The reduction of the parallelepiped to the colour triangle is then dealt with. R. C. F.

1602. Colour of Wines. A. Boutaric, L. Ferré and Madeleine Roy. *Comptes Rendus,* 204. *pp.* 343–344, *Feb.* 1, 1937.—Gives further results obtained from a spectrophotometric examination of the colour of wines [see Abstract 609 (1937)]. It is found that Beer's law is not followed when wines are diluted with alcohol, the product of optical density and volume decreasing instead of remaining constant as the wine is diluted. Dilution with distilled water gives similar results, if the optical density is measured immediately after such dilution. Mixing a coloured wine with a clear wine results in lower measured values of optical densities than those calculated using the law of mixtures. Finally, it is found that Beer's law is satisfied when a solution of alcohol and the colouring matter extracted from fresh raisins is diluted. R. C. F.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1603. Magnetic Birefringence of Solutions of Rare-Earth Salts. C. Haenny. *Ann. de Physique,* 7. *pp.* 230–290, *Feb.*, 1937.—The mode of preparation of solutions of rare-earth salts is given, and the method of measuring the birefringence and of determining absolutely the coefficients of magnetisation of these liquids at various temperatures is described. Values for the magnetic birefringence are quoted for solutions of salts of the greater part of the elements of the rare-earth series, and in particular this property is studied for different salts of the same element, Ce. The coefficients of magnetisation are measured at temperatures between 20° and 70° C. and the magnetic moments calculated. The birefringence data are in accord with and complete the information already known of the magnetic properties of the rare earths and of the magnetic rotatory power of their solutions. They are in agreement with Langevin's theory of the birefringence of paramagnetic liquids. The varations with temperature obey an extension of the Curie-Weiss law. C. J. B. C.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1604. Dependence of Luminescence on Physical Structure in Zinc Borate Compounds. D. H. Kabakjian. *Phys. Rev.* **51.** *pp.* **365–368,** *March* **1, 1937.**—Luminescent zinc borate compounds are prepared which can be obtained in either vitreous or crystalline form and can be converted from one form to the other by purely physical processes. The dependence of luminescence of compounds of this type on physical structure is investigated. It is found that changing a given compound from vitreous to granular state increases its luminescence many times. It is also found that zinc borate compounds can be made luminescent without the addition of an activator. The addition of an activator is found to result in a condensation of the emission bands and an increase in their wave-lengths. The bearing of these on the "solid solution" idea is discussed. AUTHOR.

See also Abstracts 1427, 1620, 1731.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1605. Diffusion of Light at the Surface of Separation of Two Liquids. F. Barichanskaia. *Phys. Zeits. d. Sowjetunion,* **10. 5.** *pp.* **666–672, 1936.** *In French.*—A short account is given of an experimental study of the relation between wave-length and intensity of scattering of light at the surface of separation of two liquids. Phenol-water and isobutyric acid-water interfaces are chosen for investigation. In accordance with theoretical expectations a $1/\lambda^2$ law is found. L. A. W.

1606. Optical Resolution. A. Buxton. *Phil. Mag.* **23.** *pp.* **440–442,** *March,* **1937.**—It has been assumed that the eye can separate two point-sources if the centre of one image is on the circumference of the first dark ring of the other. If a less arbitrary criterion be adopted, that the amplitude curves should interesect at their points of inflection, then the theoretical limit for resolution must be increased by 20 %. A. H.

See also Abstracts 1433, 1649, 1753.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1607. Recombination Velocity of Free Atoms. E. Rabinowitch. *Faraday Soc., Trans.* **33.** *pp.* **283–293,** *Feb.,* **1937.**—The efficiency of triple collisions is determined in the recombination of H atoms and of the halogens. The results of the determination of the velocity of homogeneous recombination of H, Br and I atoms are compared, and attention drawn to the high efficiency of the triple collision mechanism. It is suggested that no "statistical factor" should be applied to restrict the possible number of successful triple collisions. It is shown that the experiments of

Rayleigh on the long life of active N do not require the assumption that the recombination of N-atoms is a much slower process than that of H, Br, and I atoms. F. J. B.

1608. Absorption Spectra and Photosensitising Activity of White Pigments. C. F. Goodeve. *Faraday Soc., Trans.* **33.** *pp.* **340–347,** *Feb.*, **1937.**—The photosensitising power of zinc and titanium oxides, lithopone, lead carbonate and barium sulphate are discussed in relation to their absorption spectra. More accurate measurements of the absorption spectra, obtained from a study of the reflecting power, are described. Possible mechanisms for the photosensitising process are discussed. AUTHOR.

1609. Inhibition of Photochemical Reactions by Nitric Oxide. J. W. Mitchell and C. N. Hinshelwood. *Roy. Soc., Proc.* **159*A*.** *pp.* **32–45,** *March* **2, 1937.**—At 300° the quantum efficiencies of the photochemical decompositions of acetaldehyde and propionic aldehyde are reduced from large values to unity, or less, by the presence of small amounts of NO. A simple theory expresses the course of the inhibition curve. Nitric oxide is consumed in the process, 1 mol. for each light quantum absorbed by acetaldehyde, and 1 for each five absorbed by propionic aldehyde. From the amount of NO required to reduce the quantum efficiency in a given ratio, an estimate of the activation energy of the chain-propagating processes can be made, which gives results in agreement with direct determination from the temperature coefficients of the quantum yields. Methyl formate suffers an induced catalytic decomposition under the influence of radicals liberated from acetaldehyde, but methyl alcohol does not. In conjunction with results for acetone and the ethers, these results show that there is a well-defined parallelism between the susceptibility of organic molecules to the influence of alkyl radicals and their susceptibility to catalysis by iodine. AUTHORS.

1610. Desensitisation Theory. K. Weber. *Zeits. f. wiss. Phot.* **36.** *pp.* **1–8,** *Jan.*, **1937.**—Discusses the objections raised by Blau and Wambacher [see Abstract 183 (1937)] to the author's desensitisation theory, and shows that some of these objections depend on an erroneous opinion. The conclusion reached again is that the desensitisation process depends solely on effects which cause a destruction of the effectiveness of optical sensitisers. R. C. F.

1611. Sensitising Desensitisers. Lüppo-Cramer. *Zeits. f. wiss. Phot.* **36.** *pp.* **8–17,** *Jan.*, **1937.**—Examines results obtained for certain well-known desensitisers which show that, if the experimental conditions are correct, sensitisation and not desensitisation, occurs. Capri blue shows marked sensitising action for red, orange and yellow light, but for blue light desensitisation takes place, an AgBr diapositive plate and a very weak solution being used. The probable reasons for these peculiarities are discussed, the solution strength being very important. Finally, the conditions necessary for sensitisers to act as desensitisers are briefly examined, results being given for neocyanin. R. C. F.

1612. Mode of Operation of Red and Infra-Red Sensitisers. R. Mecke and G. Semerano. *Zeits. f. wiss. Phot.* **36.** *pp.* **25–32,** *Feb.*, **1937.**—Sensitisers for red and infra-red plates are basic dyestuffs and are known collectively as the polycarbocyanines. They exhibit a reducing power which, in the dissolved state, is nascent even in the dark, but which, in the adsorbed state, is initiated by light. The sensitising process is shown to be a purely photochemical reaction. H. J. H. S.

1613. Copying Possibilities of the Subtractive Three-Layer Colour Processes. F. Leiber. *Phot. Indust.* 35. *pp.* 136–142, *Feb.* 10, 1937.—Deals with the results of experiments performed on the new Agfa colour film in which the absorption curves of 6 light filters and of their photographs on the colour film are compared. The curves obtained show large differences which prove conclusively that direct copying of such colour photographs is not permissible, as such an attempt could only result in greater differences. These differences can be due to two things—the selective sensitivity of the individual layers, or the selective absorption of the original individual colours, which, owing to the special development, can here take an active part. The absorption curve of an unilluminated part of the colour film after normal reversal and of the corresponding colour layers is also given. R. C. F.

1614. Colour Kinematography. D. A. Spencer. *Phot. J.* 77. *pp.* 84–100; *Disc.*, 100–101, *Feb.*, 1937.—A comprehensive descriptive account of contemporary processes and of a few now superseded. L. V. C.

***1615. Film Camera for Kathode-Ray Oscillograph Experiments on Artificial Radioactivity. L. G. Grimmett and W. H. Rann.** *Journ. Sci. Instruments,* 14. *pp.* 96–100, *March,* 1937.—A description is given of the construction and performance of a new film camera for photographing the movements of the light spot of a kathode-ray oscillograph. Four tracks are taken on a 35 mm. film. The film speed can be varied automatically to follow the activity being studied, or set at a constant value. An automatic mechanism is provided for reversing the film at the end of the track and lifting it into position for the next track. AUTHORS.

***1616. Technique for Making Schumann Plates. P. N. Kalia.** *Indian Journ. Phys.* 10. *pp.* 457–461, *Dec.*, 1936.—Describes the procedure employed in the manufacture of Schumann plates necessitated owing to deterioration, due to delay, temperature and humidity, of imported plates. The method described is essentially the same as that given by Schumann, but in order to produce a serviceable article certain modifications and precautions become necessary in order to counteract the effect of the Indian climate. The process used is fully dealt with, and a satisfactory developer formula is also given. R. C. F.

See also Abstracts 1443, 1655, 1703, 1731.

PHOTOMETRY.

1617. Spectral Sensitivity of Receptors for Radiant Energy. P. Rossier. *Arch. des Sciences,* 18. *pp.* 199–218, *Sept.–Oct.*, *and pp.* 257–281, *Nov.–Dec.*, 1936.—The sensitivity of a receptor is given by $\sigma(\lambda) = (\lambda_s e^{1-\lambda_s/\lambda}/\lambda)^a$, where λ_s is the wave-length of maximum sensitivity and a is a measure of its sharpness. Applications of this to visual and photographic astronomical observations have been given [see Abstract 2988 (1935)]. A correction is applied to the previous calculations by use of Planck's law in the place of Wien's. The effect of stellar temperature, wave-length of the maximum sensitivity, and sharpness of the sensitive wave band are investigated. The case of a receptor with two sensitivity maxima is dealt with and applied to the use of a receptor crossed with a filter (*e.g.*, a photographic cell and a blue filter). The results are applied to Becker's observations at Berlin. H. G. C.

***1618. Physical Photometry with the Thermopile. M. Laporte and F. Gans.** *Rev. d'Optique,* 15. *pp.* 321–332, *Oct.,* 1936.—Describes in detail apparatus used for the photometry of sources of light of all kinds, using a thermopile on which is collected the radiation from the source, after it has been dispersed by two prisms and the radiation at each wave-length weighted, in accordance with the international visibility data, by means of a shaped diaphragm placed over the spectrum formed by the prisms. A Moll thermopile is used with a Zernicke galvanometer and as the sensitivity is such that 1 mm. deviation corresponds to 10^{-5} °C., the whole apparatus must be placed in a constant temperature enclosure. When this precaution is taken and the whole apparatus carefully designed an accuracy of 1 % can be attained in the photometry of sources no matter what their spectral distribution. Some details of experimental checks are given. J. W. T. W.

***1619. Photometric Test Plates. A. K. Taylor.** *Phys. Soc., Proc.* 49. *pp.* 105–110; *Disc.,* 111, *March* 1, 1937.—Characteristic curves showing the variation of reflection factor with the angles of incidence and view are given for flat plates of seven materials. Suggestions are then made as to the use of these either as substandards of reflection factor or for the measurement of illumination. AUTHOR.

See also Abstracts 1565, 1602, 1622, 1643.

POLARISATION.

1620. Polarisation of the Fluorescence of Solutions. F. Perrin. *Acta Physica Polonica,* 5. *pp.* 335–346; *Disc.,* 346–347, 1936. *In French.*—A mathematical theory of the polarisation of the fluorescence of solutions is developed, and allowance is made for the effect of the Brownian movement on rotation. The question of circularly polarised fluorescent emission is also considered. A certain amount of experimental verification is obtained for the theory. A. H.

1621. Optical Rotation and Atomic Dimension. D. H. Brauns. *Bureau of Standards, J. of Research,* 18. *pp.* 315–331, *March,* 1937.—The pure optically-active 1-fluoro-, chloro-, bromo-, and iodo-derivatives of 2-methylbutane have been prepared and values of their optical rotation, specific gravity, refractive index, and boiling point at various pressures, determined. A classification of their active forms is made, and on this basis the numerical relation of the differences of molecular rotations of these compounds (Cl-F), (Br-Cl), and (I-Br) is 41 : 18·1 : 21·6, which is in substantial agreement with the numerical relation for the differences of the respective atomic radii of the neutral halogen atoms (41 : 16 : 21). AUTHOR.

***1622. Polarisation Phenomenon in the Hilger E_1 Quartz Spectrograph. J. W. Ellis and J. Kaplan.** *J.O.S.A.* 27. *p.* 94, *Feb.,* 1937.—Following a paper by Bolla [see Abstract 5114 (1936)] on spectrophotometry with polarised light, the authors indicate where their analysis of the maxima and minima of intensity in a continuous spectrum given by a Hilger E_1 spectrograph when polarised light is used, requires modification. W. S. S.

1623. Measurement of Phase Differences by a Sensitive Method with Unlimited Range of Application. W. Herzog and G. Szivessy. *Phys. Zeits.* 38. *pp.* 129–133, *March* 1, 1937.—A thin doubly-refracting plate of known phase retardation η is used to cover only half the field, in conjunction with an analyser. In the measurements, only the analyser is rotated, and its half-shadow azimuth α is determined. The phase-difference δ can be derived from η and α. For a given value of η, the range of measurement of δ is unlimited. C. B. A.

See also Abstracts **1433, 1462, 1463, 1685, 1853.**

RADIATION, EMISSION.

1624. Temperature Variation of Cosmic Rays. J. A. Priebsch and W. Baldauf. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp*. 583–603, 1936.—The results of the three year (1932–34) series of measurements on the Hafelekar of cosmic-ray intensity, with the chamber fully shielded, are re-examined. It is shown that the previously obtained temperature coefficient, — 2·6*mJ*/°C., is too low, and a figure of — 4 *mJ*/° C. is arrived at when a correlation between temperature and pressure is taken into account. The observed seasonal variation of the cosmic-ray intensity is considered to be a result of the seasonal temperature variations. The temperature coefficient appears to be higher in the winter than in the summer. It is considered that the temperature effect is a result of the variation of the thickness of the air layer, and consequently of the scattering conditions. D. H. F.

1625. Variation of Cosmic Rays with Temperature and Solar Activity. V. F. Hess. *Terr. Mag.* 41. *pp*. 345–350, *Dec.*, 1936.—The variation of the intensity of cosmic rays with external temperature and with solar activity is reaffirmed in the face of various criticisms and the existence of irregular fluctuations of cosmic-ray ionisation is also emphasised. F. C. C.

1626. Influence of the Sun's Magnetic Field on Cosmic Rays. L. Jánossy. *Zeits. f. Physik*, 104. 5–6. *pp*. 430–433, 1937.—If the sun possesses a magnetic dipole field of $1{\cdot}7 \times 10^{34}$ gauss, then cosmic ray corpuscles with energies lower than $3{\cdot}9 \times 10^{9}$ eV cannot reach the earth, while those with energies lower than $2{\cdot}3 \times 10^{10}$ eV can only do so in definite directions. The lower limit for the cosmic-ray spectrum also follows from an independent consideration of the latitude effect. It is pointed out that a solar magnetic field of the assumed form would give rise to a solar-time period of cosmic-ray intensity. L. A. W.

1627. Cosmic Rays and Stars of the Principal Series. E. Sevin. *Comptes Rendus*, 204. *pp*. 230–233, *Jan*. 25, 1937.—It is pointed out that the ratio of the mass of the proton to that of the electron is equal to the ratio of the energy of a prominent soft photon of cosmic rays as determined by Millikan to the energy in the interior of the stars at the base of the principal series as calculated by Eddington. The agreement is not regarded as fortuitous and is shown to be in agreement with calculations based on the assumption of free spinning electrons in the stellar interior. F. C. C.

1628. Energy Loss of Cosmic-Ray Particles in Traversing Pb Screens. J. Crussard and L. Leprince-Ringuet. *Comptes Rendus*, 204. *pp*. 240–242, *Jan*. 25, 1937.—Two 0·5 cm. Pb screens, about 16 cm. apart, were placed in a cloud-chamber in a magnetic field, and the curvatures of the tracks were studied. For particles of energy between 3×10^{8} to 10^{9} V it was found that the mean loss in traversing 1 cm. of Pb was about twice as great for negative as for positive electrons. The losses are less than those observed by Anderson and Neddermeyer [see Abstract 4680 (1936)] but this is explained by the different conditions of the experiment. Some exposures in which electron-pairs were observed, and a case of disintegration where two heavy particles were emitted, are briefly discussed. D. H. F.

1629. Angular Distribution of Hard Cosmic Rays. P. Auger, P. Ehrenfest, Jr., A. Freon and A. Fournier. *Comptes Rendus,* 204. *pp.* 257–259, *Jan.* 25, 1937.—The intensity for various angles θ with the vertical was measured with three counters, between which 6 cm. screens of Pb were mounted, at levels h corresponding to 6·8, 10, 30 and 75 m. of water below the top of the atmosphere. When the counting rate is plotted against $h/\cos\theta$ (the thickness of material traversed) the points obtained at different levels do not fall on a single curve, indicating a decrease in absorption coefficient as the path length increases. The curves obtained by plotting the counting rate against $1/\cos\theta$ have approximately the same shape at each level. D. H. F.

1630. Direct Photographic Tracks of Cosmic Rays. T. Takéuchi, T. Inai, T. Sugita and M. Huzisawa. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 88–90, *Jan.,* 1937. *In English.*—Direct impressions of cosmic rays on the special α-ray plates made by the authors are shown. AUTHORS.

1631. Nature of the Soft Component of Cosmic Rays. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 51. *pp.* 217–219, *Feb.* 15, 1937.—An inquiry is made into the nature of the corpuscular entities which possess the properties necessary to explain the soft component of the cosmic radiation on the basis of the recent theory of W. F. G. Swann [see Abstract 644 (1937)]. The conclusion is reached that the most likely entities are *protons* which lose energy according to the relation $-dE/dx = \lambda E + a$, where a represents the energy lost per unit path by ionisation, and λE the energy which goes into the production of secondaries in the amount that is actually observed in the form of showers. AUTHORS.

1632. Multiplicative Showers. J. F. Carlson and J. R. Oppenheimer. *Phys. Rev.* 51. *pp.* 220–231, *Feb.* 15, 1937.—In Part I is discussed the status of the quantum theoretic formulæ for pair production and radiation in the domain of cosmic-ray energies, and the relevance of these processes to an understanding of showers and bursts. In Part II is given a qualitative estimate of the course implied by the theory for a shower or burst built up by multiplication from a very energetic primary; the diffusion equations are then set up for the equilibrium of electrons and γ-rays, and it is shown how these can be simplified. In Part III the analytic solution of the diffusion equations is carried out, and the distribution of electrons and γ-rays is found as a function of their energy, the primary energy, and the thickness and atomic number of the matter traversed. The effect of ionisation losses on the shower is treated, the amount of radiation of low energy to be expected is calculated, and transition effects in passing from one substance to another are dealt with. In Part IV are discussed the results of the calculations, and a summary of the conclusions to which they lead, and the difficulties are given. AUTHORS.

1633. Cosmic-Ray Showers. P. Auger and (Mrs.) G. Meyer. *Comptes Rendus,* 204. *pp.* 572–573, *Feb.* 22, 1937.—Measurements on showers were made with a group of four counters under a hemi-cylinder of Pb, whose thickness was varied up to 60 mm., at sea-level and at subterranean levels corresponding to 30 and 75 m. of water below the top of the atmosphere. At sea-level the curve connecting coincidence-rate with Pb thickness shows a sharp maximum at about 22 mm.; at the lower levels the curve reaches a maximum at about about 10 mm. and thereafter falls only slightly. The ratio of the maximum shower-frequencies at the different levels is approximately the same as that of the vertical intensities at the same levels. D. H. F.

1634. Absolute Intensity of Ionisation by Cosmic Rays at Sea-Level. J. Clay and H. F. Jongen. *Physica,* 4. *pp.* 245–255, *March,* 1937. *In English.*—The ionisation by cosmic rays is measured in air at pressures up to 38 atmos. between an iron cylinder of 10 cm. dia. and a cylinder of steel wires of 4 cm. dia., for various fields up to 600 V/cm. In accordance with the theory given by one of us [see Abstract 4338 (1935)] we were able to ascertain that the ionisation in the gas only, was proportional to the pressure. Above pressures of 20 atmos. the electrons from the wall produce a constant ionisation of 19 I per cm^2. iron wall per sec. when the vessel is shielded with 12·5 cm. of iron. The absolute value of the ionisation for air of one atmos. is found to be 1·10 ± 0·04 ions per cm^3. per sec. For an unshielded vessel the gas ionisation was found to be 1·66 ions per cm^3. per sec. and the ionisation from the iron wall 23 ions per cm^2. per sec. but these values are less accurate. [See also Abstract 643 (1937)]. AUTHORS.

1635. Cosmic-Ray Energy Spectrum. P. M. S. Blackett. *Roy. Soc., Proc.* 159*A. pp.* 1–18, *March* 2, 1937.—Measurements of the energy of 829 cosmic-ray tracks in a field of 12,000–14,000 gauss were made. The curvatures of high-energy tracks were measured by an optical null method, in which the curvature of the reprojected image of the track was compensated by an achromatic prism. It is found that for $E > 3 \times 10^9$ V the energy spectrum is roughly of the form $g(E) \propto E^{-s}$, where $s = 2$ for $E < 2 \times 10^{10}$, but > 2 for very high energies. (53 ± 2) % of the tracks were positively curved. The energy spectrum shows a minimum in the neighbourhood of $E = 2 \cdot 5 \times 10^9$ V, specially marked in the case of the negative particles. It is shown that the spectrum is consistent with the view that the cosmic ray suffers a chance of the order of one-half that it will be absorbed, presumably by shower-production, while passing through an energy range over $E = 2 \cdot 5 \times 10^9$ V. It is shown that about 15 % of the more penetrating rays, possibly all of the primaries, are likely to be of protonic mass, and the question of negative protons is discussed. D. H. F.

1636. Energy-Range Relation for Cosmic-Ray Particles. P. M. S. Blackett. *Roy. Soc., Proc.* 159*A. pp.* 19–31, *March* 2, 1937.—An absorption curve over the range from sea-level down to an equivalent depth of 1500 cm. of water is compiled from existing observations, and by comparison with the measured energy spectrum [see preceding Abstract] an energy-range curve is obtained. Hence the variation of energy-loss with energy of the particles is deduced. Between $E = 0$ and $E = 3 \times 10^9$ V. the energy loss is between 2 and 3 times that due to ionisation alone; between $E = 3 \times 10^9$ and 10^{10} V. the energy loss is but little greater than the ionisation loss; for energies between 10^{10} and 2×10^{10} V. the energy loss again rises to over 3 times the ionisation loss. The observed excess energy loss is attributed to loss by radiation emission and shower formation. An interpretation in terms of the cross-section for shower production is given, and the possible behaviour of particles of very high energy is described. D. H. F.

***1637. High Altitude Test of Radio-Equipped Cosmic-Ray Meter. C. D. Keen.** *Frank. Inst., J.* 223. *pp.* 355–373, *March*, 1937.—A high altitude cosmic-ray meter, of the type proposed by Benade and Doan (*Phys. Rev.* 47. *p.* 178, 1935) has been built and flown. The ionisation current in an unshielded A-filled chamber moves the mirror of a Dershem electrometer. When the reflected light beam falls on a photocell, the electrometer is discharged and the radio signal is modulated. A pressure device also modulates the signal when certain altitudes are reached. A small quantity of radioactive material introducing a small fixed ionisation makes possible convenient measurement of cosmic-ray ionisation varying through a large ratio. On April 14, 1936, a balloon flight was made from Shreveport, Louisiana. The instrument and batteries weighed 41 lbs., and were raised by three 8-ft. balloons to an altitude of 52,000 ft. During the rapid ascent the swaying of the gondola affected the electrometer mirror, and the cosmic-ray signals were irregular. More satisfactory data were obtained on the slower descent. At 78 mm. of Hg an intensity of 288 standard ions was measured. This preliminary curve is somewhat steeper than that obtained by Millikan and Bowen at about the same latitude. The test has shown that in principle the method is feasible, but that changes in the construction of the electrometer are necessary before wholly satisfactory results can be obtained.
AUTHOR.

***1638. Characteristics of Mercury-Arc Lamps. B. T. Barnes and W. E. Forsythe.** *J.O.S.A.* 27. *pp.* 83–86, *Feb.*, 1937.—Gives tables and figures of operating characteristics and radiation output from different types of Hg arc lamps. The spectral distribution in energy is measured in $\mu W/cm.^2$ at 1 m. for definite wave-length bands. The light from the low pressure Cooper-Hewitt type, the air-cooled capillary arc tube operating at pressures up to 40 atmos., and the water-cooled quartz capillary arc tube operating at pressures up to 140 atmos. is compared with light from the sun and a 500-W tungsten lamp. It is shown that, the fraction of light from a Hg arc, which is in the red end of the spectrum increases with the vapour pressure of the Hg, while the brightness at the centre of the arc for the water-cooled tube can be nearly eight times that of melting tungsten.
T. A. C.

See also Abstracts 1598, 1643, 1730.

RADIATION, GENERAL THEORY.

1639. Neutrino Theory of Light. Part II. M. Born and N. S. N. Nath. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 611–620, *Dec.*, 1936.—The authors redevelop their treatment of Jordan's neutrino theory of light [see Abstract 3183 (1936)] ascribing a spin of ½ to the neutrino in the revised treatment. The assumption of spin is neccesary to explain the polarisation of light. Planck's radiation formula is now obtained with the correct numerical factor (the previous treatment led to a formula lacking a factor 2).
W. S. S.

1640. Distribution of Velocities of Particles Undergoing Emission and Absorption in a Radiation-Field. J. Kishen and N. K. Saha. *Indian Journ. Phys.* 10. *pp.* 413–419, *Dec.*, 1936.—Following Einstein's theorems on the emission and absorption of radiation by atoms moving in a radiation field it is shown that the general distribution law of velocities of particles in such a field is Fermi-Dirac's or Bose-Einstein's according as the particles involved have antisymmetric or symmetric wave-functions. The possible application of these theorems to metal physics is discussed. AUTHORS.

1641. Spontaneous Disintegration of Photons. M. Bronstein. *Phys. Zeits. d. Sowjetunion*, 10. 5. *pp.* 686–688, 1936. *In German.*—The author outlines arguments showing (*a*) that the cosmic red displacement cannot be attributed to a conceivable spontaneous disintegration of photons in their passage through space (Halpern's hypothesis) and (*b*) that such a spontaneous disintegration is in any case impossible. W. S. S.

RADIATION, MECHANICAL EFFECTS.

See Abstract 1747.

REFLECTION, REFRACTION AND DISPERSION.

1642. Reflecting Power of Tellurium Minerals. R. Martin. *Comptes Rendus*, 204. *pp.* 598–599, *Feb.* 22, 1937.—Using an improved photoelectric method, the reflecting powers for 8 wave-lengths between 4400 and 7200 Å are determined, with Si as standard, of petzite, coloradoite, hessite (mean values), nagyagite, sylvanite and calaverite. Of the last three, being anisotropic, both maximum and minimum powers are determined. The first two and nagyagite exhibit normal dispersion, calaverite and sylvanite abnormal, while the reflecting power of hessite is practically independent of wave-length. C. A. S.

***1643. Optics : General Introduction. L. C. Martin. Optical Theory. L. C. Martin. Optical Instruments (General). L. C. Martin and B. K. Johnson. Physical Optics. F. Simeon. Ophthalmic Optics. W. Swaine. Colour-Vision. W. D. Wright. Glare. W. S. Stiles. New Light-Sources : Recent Developments in Electric Discharge Lamps. J. T. Randall.** *Phys. Soc., Reports*, 3. *pp.* 290–337, 1936.—Progress review.

1644. Selected Focal Length for Optical Systems. H. Jensen. *Zeits. f. Instrumentenk.* 57. *pp.* 75–77, *Feb.*, 1937.—Reference is made to the formula given by Roll [see Abstract 4238 (1935)] to obtain a selected focal length by the use of a method independent of the radius of curvature of the last surface. The procedure involved two steps to get a doublet system with the same refractive index as the one required. A method is given by which this formula can be determined directly without the use of supplementary refractive surfaces. R. S. R.

1645. Distortion in a Gauge Projection Lens. J. S. Anderson. *Phys. Soc., Proc.* 49. *pp.* 112–120 ; *Disc.*, 120, *March* 1, 1937.—The distortion of a lens working at finite magnification is deduced from measurements of the variation of magnification of an object as the latter is traversed across the object field or the image field. It is found that as regards attainable accuracy there is little to choose between the alternative methods of measuring an enlarged image of an object in the object field or a reduced image of an object in the image field. The technique of the method as applied to a new gauge projection lens is described. AUTHOR.

1646. Refractive Index of Water for Electromagnetic Waves 8 to 24 Cm. in Length. T. T. Goldsmith, Jr. *Phys. Rev.* 51. *pp.* 245–247, *Feb.* 15, 1937.—Wave-lengths are measured in air and water for continuous waves produced by magnetron and positive grid oscillators. Although high in absolute value, the index of refraction thus determined shows a decrease with increasing frequency, indicating a start of the drop toward the infra-red value. AUTHOR.

1647. Selective Sorption of Organic Liquids by Solid Films of Raw Linseed Oil and Stand Oil. A. P. Laurie. *Faraday Soc., Trans.* **33.** *pp.* **293–299,** *Feb.,* **1937.**—Experiments on measuring the refractive index of dry oil films by the immersion method in mixed liquids differing widely in index, reveal that a permanent reading is obtained at an index very much above or below that of the film, according to the index of the active liquid. The explanation suggested is that there is selective sorption of one of the liquids (the " active liquid ") by the film forming a surface layer having an index intermediate between that of the film and the " active liquid." Experiments with various liquids reveal a wide difference beween the index for raw oil and stand oil films, stand oil film sorbing more of liquids of negative polarity and less of liquids of positive polarity than raw linseed oil film. A possible explanation of this is given. In the case of active liquids of similar constitution, the ratio between the equilibrium index for raw oil and for stand oil, is approximately constant, and the ratio between the percentage present of the active liquid and the equilibrium index is approximately constant. Alcohol diffuses into the raw linseed oil film, while bromonaphthalene merely forms a surface layer. [See following Abstract.] AUTHOR.

1648. Refractive Index of a Solid Film of Linseed Oil. A. P. Laurie. *Roy. Soc., Proc.* **159*A*.** *pp.* **123–133,** *March* **2, 1937.**—Tests made on a solid linseed oil film having shown that it continued to rise in refractive index with age, it seemed of interest to examine the index of the oil film in pictures of different dates. The result has been to show that the index of the oil film rises with remarkable uniformity with age so far as the test has gone, thus giving some indication of the age of a picture in oil. It has also proved useful in detecting repaints, and in identifying pictures painted with egg alone as the index of the egg film does not change with age. The possibility is discussed of the method ultimately proving useful in settling the vexed question of the medium used in some of the later fifteenth-century Italian pictures, the technique of which seems to differ from both oil and egg. [See preceding Abstract.] AUTHOR.

See also Abstracts **1458, 1459, 1501, 1502, 1503, 1504, 1608, 1619, 1623, 1733.**

SPECTROSCOPY.

1649. Interferometer Wave-Lengths in the Secondary Spectrum of D_2 and HD. N. A. Kent and R. G. Lacount. *Phys. Rev.* **51.** *pp.* **241–242,** *Feb.* **15, 1937.**—Interferometer determinations of the wave-lengths of 38 lines in the spectra of D_2 and HD in the region λ 4860 to λ 5800 have been made by a crossed etalon and Littrow spectrograph. The measurements show a mean probable error of 0·0003 Å.

1650. Spectra of Barium and Strontium. Marguerite Perey. *Comptes Rendus,* **204.** *pp.* **244–246,** *Jan.* **25, 1937.**—Samples of $BaCl_2$ and $SrCl_2$ from various sources were sparked in solution. 15 new lines of Sr and 13 of Ba have been found in the ultra-violet. These have been allocated to various degrees of ionisation by varying the means of excitation. F. S.

1651. Spectra of Elements Similar to Cl I: Cl I, A II, K III, Ca IV, Ti VI, V VII, Cr VIII, Mn IX, Fe X, Co XI. B. Edlén. *Zeits. f. Physik,* **104. 5–6.** *pp.* **407–416, 1937.**—Additional data on the spectra of Cl I and K III are given. The variation of corresponding lines throughout the series is discussed. [See Abstract 1210 (1937)]. W. R. A.

1652. H.F. Excitation of Spectra in the Far Ultra-Violet. M. Hellermann. *Zeits. f. Physik*, 104. 5–6. *pp.* 417–429, 1937.—Atomic and molecular spectra in the far ultra-violet are obtained by h.f. excitation ($\lambda = 6$ m.). Since it can be applied at low pressures and low voltages, this method has advantages over others for the production of lines or bands of low excitation energy. Results are given for A, I, H_2, N_2, and NO. With O_2 only the lines of the atomic spectrum are obtained, while CO_2 gives only the CO spectrum. The lines of neutral I and the ϵ-bands of NO are observed for the first time in emission. The general type of the spectra obtained is most like that of the ordinary glow discharge. L. A. W.

1653. Far Ultra-Violet Emission of Discharge in Air at Reduced Pressure. G. Déchène. *Comptes Rendus*, 204. *pp.* 249–251, *Jan.* 25, 1937.—Reasons are given for expecting radiation in the region 1000–1200 Å from discharge in air at reduced pressure. Examination of the spectrum with a grating at grazing incidence gave the 1152 Å line of O and the 1228, 1412, 1494, 1677, 1835 and 1887 Å lines of N in addition to many lines in the ordinary ultra-violet. No line shorter than 1000 Å was recorded. F. S.

1654. Spectroscopic Study of the Magnetron Discharge. O. Luhr and F. J. Studer. *Phys. Rev.* 51. *pp.* 306–310, *March* 1, 1937.—The spectra from magnetron discharges in various gases are studied with the aim of investigating the efficiency of this type of source in producing the higher states of ionisation. The study of He was of particular interest since in a mass-spectrograph study of this type of discharge made by one of the writers, it was impossible to distinguish the He^{++} from the H_2^+ ions which were always present. The discharge between a W filament and a Ni cylinder was operated at widely varying voltages, currents and gas pressures. The most satisfactory results were obtained at about 250 V, 0·5 A and pressure of 0·1 mm. of Hg. A magnetic field of the order of 150 oersteds parallel to the axis of the cylinder greatly intensified most of the lines in the region of the spectrum investigated between 7000 and 2000 Å. Higher members of the series in both the He I and He II spectrum were brought out with good intensity compared with results obtained with other types of discharge. The magnetron should thus be an efficient source of He^{++} ions. In the case of N and Hg many lines of the N II, N III, N IV and Hg II spectra were identified. AUTHORS.

1655. Spectroscopy: Atomic Spectra. M. F. Crawford; Astronomical Spectroscopy. A. Hunter; Application of Spectroscopy to Photochemistry. R. W. B. Pearse; Rotation-Vibration Spectra of the Lighter Hydrocarbons. W. H. J. Childs. *Phys. Soc., Reports*, 3. *pp.* 369–394, 1936.—Progress review.

1656. Spectrum of Singly Ionised Zinc. P. N. Kalia. *Indian Journ. Phys.* 10. *pp.* 463–464, *Dec.*, 1936.—Of some 63 lines of Zn II between λ 4568 and λ 2265 some 33 are accounted for in the present analysis. 11 lines are found to be due to combinations between already known terms, whilst the other 22 appear to be due to combinations with the known terms of 8 new terms. A. H.

1657. Modification of Spectral Lines by Very Close Collisions. W. M. Preston. *Phys. Rev.* 51. *pp.* 298–306, *March* 1, 1937.—As a result of a survey of the spectra of Hg, Cd and Tl when a few cm. pressure of a rare gas is added to a discharge through the vapour of these metals, it is concluded that bands of the type first reported by Oldenberg on the short wave-length side of the resonance line Hg 2536·7 probably occur with all metal lines, and with a total relative intensity of the same order of magnitude. The effect of collision induced emission seems in general to be negligible. The occasional appearance of diffuse maxima may be explained by a chance relationship between the potential curves which describe the interaction of the colliding atoms. AUTHOR.

1658. Nuclear Moment of Zn^{67}. J. M. Lyshede and E. Rasmussen. *Zeits. f. Physik,* 104. 5–6. *pp.* 434–439, 1937.—Weak satellites ascribable to Zn^{67} are found on intense hyperfine structure exposures of the blue Zn triplet $4s4p\,{}^3P - 4s5s\,{}^3S$, of which reproductions are given. The analysis of the structures makes very probable the value $i = 5/2$ for the spin of the Zn^{67} nucleus and $+ 0{\cdot}9$ nuclear magneton for its magnetic moment. L. A. W.

1659. Quadrupole Moment and Magnetic Moment of ${}^{115}_{49}In$. H. Schüler and T. Schmidt. *Zeits. f. Physik,* 104. 5–6, *pp.* 468–471, 1937.—From a new determination of the hyperfine structure of the In I line λ 4511 ($5s^2 5p\,{}^2P_{3/2} - 5s^2 6s\,{}^2S_{1/2}$) the quadrupole moment of ${}^{115}_{49}In$ is deduced to be $q = + 0{\cdot}8 \pm 0{\cdot}2 \times 10^{-24}$. A discussion of the magnetic moments of the In and Tl nuclei leads to adoption of the values $\mu = 5{\cdot}3 \pm 0{\cdot}5$ and $1{\cdot}45 \pm 0{\cdot}1$ nuclear magnetons respectively. J. E. K.

1660. Fine Structure of the Balmer Lines. B. S. M. Rao. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 56–62, *Jan.,* 1937.—In an attempt to resolve the disagreement between the calculated and observed fine structure of the Balmer lines a correction is introduced for the interaction of the electron with its own radiation field. It is found that the correction accounts for only some 2 % of the observed discrepancy. A. H.

1661. Band Spectrum of Gallium Oxide and Isotope Effect of Gallium. M. K. Sen. *Indian Journ. Phys.* 10. *pp.* 429–445, *Dec.,* 1936.—From measurements on plates taken with moderate dispersion prism spectrographs of large light gathering power, a number of new bands have been added to the existing data. The vibrational analysis given by Guernsey [see Abstract 3736 (1934)] is in the main confirmed and extended to $v' = 14$ and $v'' = 14$. But the double heads, which she attributed to R_1 and R_2 branches, are found to be definitely due to the isotopic molecules, $Ga^{69}O$ and $Ga^{71}O$. This has been confirmed also from the author's own plates wherever possible. AUTHOR.

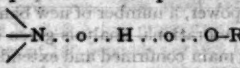
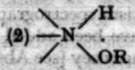
1662. Band Spectrum of Cobalt Hydride. A. Heimer. *Zeits. f. Physik,* 104. 5–6. *pp.* 448–457, 1937.—A band spectrum of cobalt hydride is successfully excited in a King resistance oven containing H_2 at 2/3 atmosphere pressure and Co heated to 2300–2400° C. Two bands at 4493 and 4203 Å are measured and analysed. These bands, which have the same end state, are interpreted as the 0–0 and 1–0 bands of a ${}^3\Phi'_4 - {}^3\Phi''_4$ band system. The more important band data are deduced and tabulated. A perturbation in ${}^3\Phi'_4$, $v' = 0$, and the electron configuration and the intensity relations within the 0–0 band are discussed. J. E. K.

1663. λ2708 and λ2756 Bands of OD. M. Ishaq. *Roy. Soc., Proc.* 159*A*. *pp.* 110–122, *March* 2, 1937.—The λ2708 and λ2756 bands of OD have been photographed on an E 1 Hilger quartz spectrograph. The bands like those of OH at λ2608 and λ2677 are the (2, 0) and (3, 1) bands of a ${}^2\Sigma \updownarrow {}^2\Pi_{1av.}$ transition. An analysis of the rotational structure has been made and the values of the rotational constants have been determined. The values of the constants are compared with those for the corresponding OH bands. AUTHOR.

1664. Infra-Red Absorption Spectrum of Naphthalene Vapour. D. Bârcă-Gălăţeanu. *Soc. Roumaine Phys., Bull.* 37. 67. *pp.* 19–34, 1936. *In German.*—Naphthalene vapour has been studied between 1·5 and 20μ and several new bands are reported. With the help of the Ellis relations the bands are arranged in series and the differences between observed and calculated values are small. W. R. A.

1665. Near Infra-Red Absorption Spectra of Amines. P. Barchewitz. *Comptes Rendus,* 204. *pp.* 246–249, *Jan.* 25, 1937.—The measurements were made with a registering photoelectric spectrometer previously described [see Abstract 5576 (1936)]. Both pure and dissolved amines were investigated. The bands found are third and fourth harmonics of bands near 3μ, and are displaced towards shorter wave-length with rise in the homologous series. F. S.

1666. OH Band of Monomolecules of Alcohol near 3μ. J. Errera and P. Mollet. *Comptes Rendus,* 204. *pp.* 259–261, *Jan.* 25, 1937.—In very dilute (less than 3 *M*) solutions of aliphatic alcohols in CCl_4 and CS_2 an absorption band at 3640 cm.$^{-1}$ due to OH vibrations of isolated single molecules is observed whilst the band at 3350 cm.$^{-1}$ due to the OH vibrations between an O atom of one molecule and an H atom of another disappears. Increasing temperature increases the intensity of 3640 and decreases that of 3350. Observation of the absorption of the vapour supports this view, the 3350 band disappearing at low pressure when the 3640 absorption is still strong. H. G. C.

1667. Near Infra-Red Absorption of Mixtures of Amines and Alcohols. Marie Freymann. *Comptes Rendus,* 204. *pp.* 261–263, *Jan.* 25, 1937.—Solutions of alcohols in amines show reductions in the intensity of the OH band whilst with the same concentration in CCl_4 the band is strong. The concentration at which the band disappears is dependent on temperature. The phenomenon may be due to the formation of (1)  $>N\,.\,.\,o\,.\,.\,H\,.\,.\,o\,:\,.\,O{-}R$ (monoelectronic bond) or (2)  $>N{\lessdot}\genfrac{}{}{0pt}{}{H}{OR}$. The NH absorption which would be expected from formula (2) is absent. H. G. C.

1668. Infra-Red Absorption Spectra of Methyl Cyanide and Methyl Isocyanide. R. M. Badger and S. H. Bauer. *Am. Chem. Soc., J.* 59. *pp.* 303–305, *Feb.,* 1937.—A vibrational analysis is made of the spectra of methyl cyanide and methyl isocyanide. Evidence is given which indicates that although the C-N linkage in the isocyanide approaches rather closely to a triple bond it does possess an appreciable amount of double bond character. This, however, does not produce any deviation from linearity in the $C - N \equiv C$ group and methyl isocyanide appears to possess a threefold axis of symmetry. The absorption spectra of methyl isocyanide in the liquid state, and of methyl cyanide in the liquid and vapour states are photographed in the photographic infra-red. AUTHORS.

1669. Infra-Red Absorption of Heavy Acid Solutions. D. Williams and E. K. Plyler. *Am. Chem. Soc., J.* 59. *pp.* 319–321, *Feb.,* 1937.—The infra-red absorption of D_2O and of DCl, D_2SO_4 and D_3PO_4 solutions has been measured in the region between 2 μ and 12 μ. In addition to the bands at 2·9, 4·0, 6·8 and 8·2 μ, a band at 10·4 μ has been found in the spectrum of D_2O. In the spectra of all the heavy acid solutions studied intense absorption bands appear at 3·4 μ and near 5·5 μ in addition to the bands characteristic of the solvent. The solutions of

D_2SO_4 and D_3PO_4 also give rise to characteristic SO_4 and PO_4 absorption, respectively. The intense bands at 3·4 and 5·5 μ are attributed to hydration effects. AUTHORS.

1670. Infra-Red Absorption Spectra of Four Grignard Solutions. W. B. Plum. *J. Chem. Phys.* 5. *pp.* 172–178, *March*, 1937.—Absorption spectra are reported for 12 liquids: 4 typical Grignard solutions, and 8 related substances, for the range 1·0 to 13 μ. Absorption frequencies at 784, 910, 4250 and possibly 1950 cm.$^{-1}$ appear to be associated with compounds which contain Mg. Possible origins of these frequencies are discussed. AUTHOR.

1671. Near Infra-Red Absorption Spectrum of Bromine. O. Darbyshire. *Roy. Soc., Proc.* 159*A*. *pp.* 93–109, *March* 2, 1937.—With a view to the determination of the correction to be applied to the provisional numeration of the upper state of the extreme red absorption system of bromine the photography and analysis of the system have been extended from 7600 to 8180 Å. The main system after being unobservable between 6600 and 7100 Å, where the extreme red system is most strongly developed, reappears, co-exists with, and then above 8180Å extends beyond the extreme red system. Three isotope head separations of the extreme red system have been measured and from them a most probable numeration increase of 7 units with a possible error of ±2 is predicted, a result which accords with other less precise considerations. Vibrational constants of the $^1\Sigma_g^+$ and $^3\Pi_{0+u}$ states have been redetermined and those of the $^3\Pi_{1u}$ state evaluated on the basis of a numeration increase of 7 units. According to this amendment the ω_e values, and hence the r_e values, of the $^3\Pi_{0+u}$ and $^3\Pi_{1u}$ states are almost equal. The interpretation of the results of recent work by Acton *et al.* [see Abstract 4222 (1936)] on the absorption continuum of bromine is discussed with reference to Franck-Condon predictions from potential energy curves calculated from the new data. AUTHOR.

1672. Near Infra-Red Absorption Spectrum of Heavy Water. L. Kellner. *Roy. Soc., Proc.* 159*A*. *pp.* 410–415, *April* 1, 1937.—An investigation of the infra-red absorption of heavy water in the region 0·9–2·1 μ. Four absorption bands due to the vibrations of the D_2O molecule are found whose positions are given in Table 1 of the original. The results are compared with previous observations. It is shown that these bands can be explained as certain overtones and combination tones of the three fundamentals in the same way as the corresponding bands of light water vapour have been interpreted by Mecke. AUTHOR.

1673. Rotation-Vibration Spectra of Polyatomic Molecules in the Photographic Infra-Red. H. Verleger. *Phys. Zeits.* 38. *pp.* 83–103, *Feb.* 1, 1937.—The author gives a review of recent work on the structure of simple molecules containing H or D. After a short general account of rotation-vibration band spectra, more detailed sections are devoted to the results of various workers upon the following molecules: CO_2, HCN, C_2H_2 and C_2HD, N_3H, CH_3Cl, CH_3Br and CH_3I, CH_3OH, CH_3N_3, CH_3C_2H, CH_4 and CH_3D, HCOOH, NH_3 and ND_3, H_2O, HDO and D_2O, and HNCO. A number of infra-red band spectrograms taken with a 3-m. grating are reproduced. Reference is also made to work on more complicated molecules and a Bibliography containing 75 items is appended. L. A. W.

1674. Absorption Spectrum of Nitrocellulose. K. Masaki. *Chem. Soc. Japan, Bull.* 12. *pp.* 1–3, *Jan.*, 1937. *In English.*—Because of the difficulty of obtaining concentrated solutions of nitrocellulose in solvents which do not absorb in the ultra-violet the absorption is studied by making thin films and studying the absorption of a pile of these. It is concluded that the absorption must be attributed to the nitro-groups.
A. H.

1675. Ultra-Violet Absorption of Ionic Crystals. E. G. Schneider and H. M. O'Bryan. *Phys. Rev.* 51. *pp.* 293–298, *March* 1, 1937.—In order to extend the measurements of Hilsch and Pohl on the u.v. absorption bands of the alkali halides below 1600 Å, LiF has been used as a support for thin films of the salts. Selected LiF plates of 1 mm. thickness when properly cleaned were consistently transparent to 1050 Å. The compound to be studied was distilled on to the LiF within a Thibaud spectrograph. A silver solder-carboloy hot spark and Ilford Q plates were used to make the measurements. Comparison of spectra transmitted by the LiF plates with and without absorbing films of approximately 0·05 μ thickness show, in addition to the bands reported by Hilsch and Pohl, a number of bands below 1600 Å whose widths vary between 0·3 and 1·3 eV. Observations made on some of these compounds by A. Smith, using a less direct method, agree very poorly with these measurements. A comparison of the observed bands with the computations by A. v. Hippel shows fairly complete agreement. Results on several other halides show only a series of sharp absorption edges with continuous absorption toward shorter wave-lengths.
AUTHORS.

1676. Ultra-Violet Absorption Spectra of Iodoform and of Other Tri-Iodides in Solution. R. H. Potterill and O. J. Walker. *Faraday Soc., Trans.* 33. *pp.* 363–371, *March*, 1937.—The absorption spectra of iodoform and of methyl iodoform in alcohol and in cyclohexane are measured for the wave-length range 2000–4000 Å. The absorption curves of both substances are very similar to one another and differ from the curve characteristic of I_3^-. The absorption spectra of PI_3, AsI_3 and SbI_3 in cyclohexane are measured and compared with that of iodoform. The results are discussed in relation to the absorption of iodides in general.
AUTHORS.

1677. Near Ultra-Violet Absorption System of Cyanogen. System I. Sho-Chow Woo and Ta-Kong Liu. *J. Chem. Phys.* 5. *pp.* 161–165, *March*, 1937.—A new system of absorption bands has been found in the region λλ3020–2400 with an absorbing path of 3 m. and a pressure of 2 atmos. The gross structure of the system is comparatively simple. Two main progressions of bands with frequency differences 2050 cm^{-1}. and 895 cm^{-1}. have been found. The bands in these progressions can be accurately represented by a general formula: $\nu = A + \omega_1'v_1' + x_{11}'v_1'^2 + \omega_2'v_2' + x_{22}'v_2'^2 + x_{12}'v_1'v_2'$ with $A = 33{,}293 \cdot 63$, $\omega_1' + x_1' = 895 \cdot 75$, $\omega_2' = 2065 \cdot 38$, $x_{22}' = -15 \cdot 13$ and $x_{12}' = -8 \cdot 00$. The electronic excitation is mainly at the C–N bond. The structure of the molecule in the excited state, its normal frequencies and symmetry properties are also discussed. The frequency difference 2050 cm^{-1}. is considered as due to the totally symmetric longitudinal (C–N) vibration in the excited state and a tentative assignment is suggested as follows: $\nu_1' = 895$ cm^{-1}., $\nu_2' = 2050$ cm^{-1}., $\nu_3' = 1770$ cm^{-1}., $\delta_2'\ (u) = 210$ cm^{-1}. Other possible assignment is briefly discussed.
AUTHORS.

1678. Dependence of Predissociation Limit on Rotational Energy. M. Eliashevich and B. Stepanov. *Phys. Zeits. d. Sowjetunion,* 10. 6. *pp.* 703–710, 1936. *In English.*—The dependence of the predissociation limit on the rotational quantum number J differs for different types of predissociation. The various cases that may occur are here considered. It is discussed under what conditions predissociation limits in several successive bands are likely to be met with. It is shown that a case is possible when only the lower rotational levels of a band are predissociated. AUTHORS.

1679. Structure of the Band System of Mercury Vapour. S. Mrozowski. *Zeits. f. Physik,* 104. 3–4. *pp.* 228–247, 1937.—The author derives a scheme of potential curves for the different states of the molecule Hg_2. The structure of the fluctuation bands, the effect of collisons and the mechanism of the fluorescence phenomena are dealt with in detail. W. S. S.

1680. Vibration Frequencies of Polyatomic Molecules. R. Mecke. *Zeits. f. Physik,* 104. 3–4. *pp.* 291–302, 1937.—It is necessary to postulate a molecular model, so that the observed frequencies can be related to it. Such a model is most convenient if chemical ideas, such as that of valency, can be ascribed to features in it. It is only justified in so far as it leads to a consistent scheme of elastic constants, not directly observable. The particular scheme of calculation employs models in which the molecule is imagined to be divided into atomic groups, to each of which particular group-vibrations are ascribed, and the vibrations of each group are mechanically coupled with those of other groups. Such coupled group-vibrations are then identified with the observed vibrations of the molecule as a whole. The coupling process is easily given in terms of the model. A. C. M.

1681. Fine Structure in the $^3\Sigma$ Ground State of the Oxygen Molecule, and the Rotational Intensity Distribution in the Atmospheric Oxygen Band. R. Schlapp. *Phys. Rev.* 51. *pp.* 342–345, *March* 1, 1937.—The formula developed by Kramers (and recently on different lines by Hebb) to represent the fine structure of the ground state of O_2 is compared with the experimental data. It is pointed out that the currently accepted values of the parameters are in error. The measurements are compared with a more accurate formula, which takes into account the fact that the rotation does not completely decouple the spin from the axis of the molecule, and values of the parameters are found which give excellent agrement. The rotational intensity distribution in the atmospheric O_2 bands is recalculated on the assumption of incomplete decoupling; the intensities in the ^PP and ^RR branches are found to be unchanged, while those in ^PQ and ^RQ become more nearly equal than with complete decoupling, a result in harmony with the measurements. AUTHOR.

1682. Electronic Energy Levels of Simple Hydrides. J. R. Stehn. *J. Chem. Phys.* 5. *pp.* 186–191, *March,* 1937.—The conventional extremely simplified form of the Heitler-London theory is applied to the energy levels of the molecules BH, CH, NH, OH, FH. The exchange integrals, determined empirically to make the theory fit the known levels, are found to vary slowly and regularly from one molecule to the next. The energies of states as yet unobserved are predicted. AUTHOR.

1683. Energy States of Solids, Particularly $Nd_2(SO_4)_3 \cdot 8H_2O$. F. H. Spedding, H. F. Hamlin and G. C. Nutting. *J. Chem. Phys.* 5. *pp.* 191–198, *March*, 1937.—The absorption spectrum of $Nd_2(SO_4)_3 \cdot 8H_2O$ crystals has been photographed at 20°, 78°, 169° and 298° K. The absorption lines occur in multiplets and originate in transitions from two low excited states as well as from the normal state. The excited levels of the basic multiplet are situated 77 and 620 cm^{-1}. above the lowest state and undoubtedly arise through splitting of the normal state of the free Nd^{+++} ion in the electric field set up by its immediate neighbours in the crystal lattice. The positions of the observed levels are not in accord with conclusions of Penney and Schlapp from their study of the influence of crystal fields on the temperature variation of the paramagnetic susceptibility of Nd ion in $Nd_2(SO_4)_3 \cdot 8H_2O$. Based in part upon the susceptibility measurements of Gorter and de Haas, Penney and Schlapp's work requires that the levels be at 0, 243 and 834 cm^{-1}. If the data of Gorter and de Haas may be considered in error as regards absolute values the positions of the levels we have found are in excellent agreement with predictions of the theories of van Vleck and Penney and Schlapp, and with the experimental results of Meyer and of Zernicke and James. AUTHORS.

1684. Absorption Spectrum of Water between 2·5 and 6·5 μ. E. Ganz. *Ann. d. Physik*, 28. 5. *pp.* 445–457, *March*, 1937.—Three absorption bands are studied. The thickness of the absorbing layer varies between 5 and 200 μ. In this region the absorption coefficient is not independent of the thickness, but decreases very much with increasing thickness. This is attributed to scattering, but no attempt is made to correct for the influence of scattering. The variation of the band with temperature up to 84° C. and the influence of dissolved ions are also studied. R. P.

1685. Fluorescence Spectra of Impurity Molecules in Crystals. K. S. Krishnan and P. K. Seshan. *Acta Physica Polonica*, 5. *pp.* 289–299, 1936. *In English.*—An extension of work described earlier [see Abstract 58 (1935)] when it was found that single crystals of anthracene and chrysene, containing traces of naphthacene as impurity, gave strongly polarised absorption bands suggesting preferential orientation of the naphthacene molecules in the crystal. The directional properties of fluorescence of naphthacene molecules are now studied. It is found that light vibrations in the plane of the molecule excite fluorescence in it much more strongly than light vibrating along the normal to the plane, and that this fluorescent light is polarised similarly to the exciting light. A. H.

1686. Fluorescence and Absorption Spectra of Hydrocarbons Containing Benzene Nuclei. R. Titeica. *Acta Physica Polonica*, 5. *pp.* 381–389; *Disc.*, 389–392, 1936. *In French.*—Fluorescence and adsorption spectra are determined for the following hydrocarbons: diphenyl, diphenylmethane, dibenzyl, stilbene and benzyldiphenyl. In general the characteristic band structures due to the benzene nucleus are little affected by constitutive changes, but introduction of a double bond into dibenzyl so as to give stilbene entirely changes the spectral type. Benzene and naphthalene are studied in alcoholic solution and results are also given for the higher members of the condensed ring compounds, chrysene and pyrene. Four fundamental frequencies are deduced. The numerical values, which cannot be determined exactly owing to the difficulty in deciding the exact position of the observed bands, are approximately 170 $cm.^{-1}$ (absorption), 450 $cm.^{-1}$ (fluorescence and absorption), 920 cm^{-1}. (benzene absorption) and 1450 cm^{-1}. (absorption). Spectrograms are reproduced. L. A. W.

1687. Resolution and Interpretation of the Luminescent Spectra of Solids at Low Temperatures. J. Ewles. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 277–280, *Jan.*, 1937.—Resolution of the spectra of the luminescence of certain solids of the Lenard and Klatt type has been obtained at the temperature of liquid air. The interpretation of the spectra shows that the luminescence is derived from an atom or ion of the parent lattice still associated with the lattice. A theory of phosphorescence is put forward based on the experimentally discovered ubiquity of the metastable levels. AUTHOR.

1688. Zeeman Effect of N II. J. B. Green and H. N. Maxwell. *Phys. Rev.* 51. *pp.* 243–245, *Feb.* 15, 1937.—The Zeeman effect of N II is studied at field strengths of about 36,000 gauss. By using He as residual gas with a small N impurity, the spectrum is strongly excited, especially in the visible region. Edlén's corrections to Freeman's classification are verified. Except in a few important cases, g values are LS within experimental error. The exceptions are considered in detail. AUTHORS.

1689. Transition from the Zeeman to the Paschen-Back Effect in Resonance Radiation. P. Soleillet. *Comptes Rendus*, 204. *pp.* 570–571, *Feb.* 22, 1937.—Expressions are derived for the polarisations of the components of the Cd line 2288 Å, for the odd isotopes of nuclear spin ½, where the separation of the components is not large compared with their natural width and where the magnetic separation of the levels remains proportional to the field over a small range only. A number of conclusions are drawn from the expressions. D. H. F.

1690. Raman Spectrum of Thiophene. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 24. *pp.* 207–212, *Oct.*, 1936.—The positions of many lines in the Raman and infra-red spectra of thiophene, both from the investigations of the authors and from those of other observers, are given in a table, and a comparison is made between various results. An important point in view of future discussions is that in the infra-red absorption two strong maxima appear, respectively at 1540 and 1240 cm.$^{-1}$, which do not find any correspondence in the Raman effect, at least amongst the feeble lines which are seen superposing the spectra strongly. Yet in the Raman spectrum the two lines re-appear with notable intensity. Further research on the subject is required. [See following Abstract]. J. J. S.

1691. Molecular Symmetry of Thiophene. G. B. Bonino. *Accad. Lincei, Atti*, 24. *pp.* 288–294, *Nov.* 1, 1936.—Referring to his previous paper [see preceding Abstract] the author, basing his remarks on the ideas developed chiefly by Wigner and by Tisza, takes into account some considerations relative to the characteristic oscillations which can be attributed to the molecule of thiophene in relation to the elements of symmetry which may be supposed to exist in the same. The discussion of other symmetrical characters which may actually be present in the molecule is postponed to a later paper. J. J. S.

1692. Raman Spectra of Oxalates and Oxalato-Complexes: Vibrations of Dicarboxyl. J. Gupta. *Indian Journ. Phys.* 10. *pp.* 465–472, *Dec.*, 1936.—In continuation of the author's work on the Raman spectra of oxalic acid and metallic oxalates [see Abstract 3685 (1936)], the oxalato-complexes of Al and Ti have been examined with a view to testing the validity of the views on the structure of the ionised carboxyl group put forward in previous papers. A general confirmation has been obtained, in view of certain remarkable changes observed in the spectra of the oxalate group, such as the disappearance of the line 1306 and the band 1620 of the oxalate ion, and the appearance of two lines 1680 and 1730, in the spectrum of potassium alumino-oxalate. The spectra also reveal the less stable character of the Ti complex. An attempt has been made to characterise the modes of oscillations of the (C_2O_4) ion and identify them with the Raman lines of the oxalates, on the basis of vibrations of C_2H_4, analysed by other workers. Also, from the appearance of two lines 1680 and 1730 in the spectra of the complexes, in place of only one observed in the case of the esters, it is suggested that in the complex, the two carbonyl linkages are of different energy contents, and hence the possibility of existence of an interesting form of isomerism is pointed out. AUTHORS.

1693. Raman Spectrum of Deutero-Sulphuric Acid. A. H. Leckie. *Faraday Soc., Trans.* 32. *pp.* 1700–1705, *Dec.*, 1936.—The Raman spectrum of D_2SO_4, in the pure form, and at various concentrations in D_2O is determined. Certain of the lines show small isotope shifts, together with frequency changes on dilution. By comparing these with the corresponding values in H_2SO_4 evidence is obtained in support of the view of Woodward and Horner that many of the lines are composite in character. The generally accepted assignments are reviewed from the standpoint of the results obtained for D_2SO_4. AUTHOR.

1694. Depolarisation of Raman Lines and Structure of Chlorate, Bromate and Iodate Ions. S. T. Shen, Y. T. Yao and Ta-You Wu. *Phys. Rev.* 51. *pp.* 235–240, *Feb.* 15, 1937.—The Raman spectra of chlorate ClO_3, bromate BrO_3 and iodate IO_3 in solutions are examined under high dispersion and the degrees of depolarisation of the Raman lines measured. It is shown that the strong line at 930 cm.$^{-1}$ of ClO_3 and that at 800 cm.$^{-1}$ of IO_3 in solutions, which are regarded as single lines in the literature, are each really composed of two lines. The presence of four lines in each ion in the Raman effect, together with the depolarisation measurement, and the infra-red data, shows that these ions have pyramidal structure. The valence force constants of these ions are calculated from the present data according to the equations of Lechner. AUTHORS.

1695. Raman Spectrum of Benzene Vapour. S. Bhagavantam and A. V. Rao. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 18–22, *Jan.*, 1937.—The Raman spectra of benzene in the liquid and vapour states have been photographed alongside each other under identical conditions of slit width and illumination. While the 600 and 992 Raman lines show no shift, the line at 3061 shifts to 3069 as we pass from the liquid to the vapour. The Raman line at 3047 observed in the liquid has either completely disappeared or considerably weakened in the vapour. The rotation wings accompanying the Rayleigh lines in the liquid show no intensity maximum separated from the centre whereas there is a distinct maximum in the case of the vapour. This result is demonstrated with the help of microphotometric records. The distribution of intensity within the wings in the case of the liquid is very different from that obtained in the case of the vapour. When judged by comparing with the 992 Raman line, a very considerable fall in the absolute intensity of the wings is noticed as we pass from the vapour to the liquid. The significance of this result is discussed. AUTHORS.

1696. Oscillations of the Carbon Chain in the Benzene Molecule. P. Donzelot and J. Barriol. *Comptes Rendus*, 204. *pp.* 581–582, *Feb.* 22, 1937.—Calculations are given showing that oscillations of the C_6 ring account for the lines of frequencies 994 (polarised), and 1584 (depolarised) in the diffusion spectrum of benzene, and similarly for the lines 800 (polarised) and 1264 (depolarised) in that of cyclohexane. In both cases the effect of the C–H linkages is negligible. C. A. S.

1697. Raman Spectra of Water, Aqueous Solutions and Ice. J. H. Hibben. *J. Chem. Phys.* 5. *pp.* 166–172, *March,* 1937.—The Raman spectra of water at different temperatures of aqueous solutions and of ice are discussed in detail. Several low frequency shifts such as $\Delta\bar{\nu}$ 150, 445 and the shift at 2170 are easily discernible if u.v. excitation is used. The first two of these vary markedly in intensity with temperature changes and are affected by some solutes. All three are present in ice at slightly displaced frequencies. At least some of these frequencies may be ascribed to the intermolecular influences. Whatever may be the mechanism of polymerisation or association these results indicate that effectively such a state exists and is a function of environmental conditions. AUTHOR.

1698. Spectra of the Disubstituted Acetylenes and of the Mustard Oils. R. M. Badger. *J. Chem. Phys.* 5. *pp.* 178–180, *March,* 1937.—The doubling of the Raman line due to the $C \equiv C$ vibration in disubstituted acetylenes and that of $C \equiv N$ in the mustard oils is explained by postulating a Fermi resonance interaction between the $C \equiv C$ or $C \equiv N$ fundamental and an overtone of another frequency. This frequency may be the symmetrical or unsymmetrical vibration in the $C - C \equiv C - C$ group involving stretching and compression of the $C - C$ bonds or less likely the vibration involving swinging of the H atoms of the end C atoms. In the mustard oils vibration is probably that of the $C - N$ vibration. Disubstitution in the acetylenes is necessary to bring the frequencies sufficiently close to interact, hence in the monosubstituted compounds the levels are single. H. G. C.

1699. Raman Spectra and Latent Heat of Fusion of Non-Associated Substances. C. J. Phillips. *Indian Journ. Phys.* 10. *pp.* 447–456, *Dec.,* 1936.—The relationship $\lambda = m\mathrm{N}hc/\mathrm{JML}_f = m(2{\cdot}845)/\mathrm{ML}_f$, where $m = 1, 2\ldots$, N = Avogadro's number, h = Planck's constant, c = velocity of light, J = Joule's equivalent, M = molecular weight, and L_f = latent heat of fusion, is applied to 38 organic and inorganic substances in the crystalline and liquid states. For each substance a Raman shift can be found which is equal to the calculated frequency, both being expressed in wave numbers. In all but five cases, the calculated Raman shifts lie within the range 350 cm^{-1}. to 1600 cm^{-1}. although the molecular weights vary in a 6 to 1 ratio and the latent heats of fusion in a 21 to 1 ratio. The relationship apparently holds only for non-associated substances. There are remarkable similarities between the calculated values for various homologous compounds. AUTHOR.

1700. Raman Spectra of Crystal Modifications. S. C. Sirkar and J. Gupta. *Indian Journ. Phys.* 10. *pp.* 473–481, *Dec.,* 1936.—The Raman spectra of different modifications of crystals of *p*-dichlorobenzene, *p*-dibromobenzene and S have been studied at different temperatures including that of liquid air. It has been observed that in the case of the last two of the above substances no abrupt change takes place with the transformation from one modification to the other in the positions of the new lines which appear in the case of the solid state in the neighbourhood of the Rayleigh line. In the case of *p*-dichlorobenzene, however, not only some of these new lines but also some Raman lines due to intermolecular vibration of the single molecule are shifted on cooling the crystals once in ice, and it is not definitely known whether the lattice is changed with this cooling. On lowering the temperature of the crystals of the first two substances to that of liquid air, the new lines are shifted away from the Rayleigh line, but the linear coefficient of expansion calculated from the magnitude of these shifts with the help of the theory of lattice oscillation seems to be too high. The above results are discussed and it is suggested that the lines in question may have their origin in vibrations of polymerised groups. AUTHORS.

1701. Raman Spectra of Crystal Powders. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 5*A*. *pp*. 76–93, *Jan*., 1937.—The crystal-powder method of Menzies and Bär is improved by the use of complementary filters. The original method does not allow faint lines to be photographed, on account of the overlaying of them by direct light entering the spectrograph and reflected from the walls, etc. of the camera. The improvement consists in filtering out the exciting line by a filter placed between the scattering substance and the spectrograph slit. Iodine in CCl_4 is used to isolate 4047 Å from the Hg spectrum, and it is used as the exciting line. It is then in turn extinguished by $NaNO_2$ solution, which cuts off near to 4047 Å, so allowing the Raman lines to pass. The ammonium halides and sulphate are examined, and the vibrations of the NH_4 ion are considered. The vibrations of $NH_3OH \cdot HCl$, $(NH_3OH)_2 \cdot H_2SO_4$, $N_2H_4 \cdot 2HCl$ and $N_2H_4 \cdot H_2SO_4$ are discussed. The N–H bands appear multiple and diffuse. From a comparison of the spectra of tri- and pentavalent N-derivations, it is concluded that when the covalency of N changes from 3 to 4, there is a weakening of the N-K bond. A. C. M.

1702. Influence of Temperature on the Raman Lines of Topaz, Beryl and Calcite Crystals. T. Kopcewicz. *J. de Physique et le Radium*, 8. *pp*. 6–10, *Jan*., 1937.—The Raman spectra of crystals of beryl, topaz and calcite are photographed at various temperatures up to about 500° C. The vibration-frequencies show a slight diminution of wave-length with increasing temperature. The order of these displacements is calculated theoretically in the case of calcite, and the frequencies are identified with those observed in the infra-red. A. C. M.

1703. U.V. Emission during Slow Decomposition of Nitrides. R. Audubert and H. Muraour. *Comptes Rendus*, 204. *pp*. 431–432, *Feb*. 8, 1937.—Using a CuI photo-counter which has a mean wave-length of sensitivity at 2150 Å and is capable of detecting one or two photons per sec. per cm^2., it is shown that the slow thermal decomposition of nitrides is accompanied by the emission of u.v. radiation, the intensity being relatively high from the nitrides of Na, K, Pb and Ag, but very feeble from those of Ca and Ba. It increases rapidly with temperature. Photons and N_2 appear simultaneously from the alkali nitrides, but the N_2 is emitted first from the lead nitride. C. B. A.

See also Abstracts 1416, 1418, 1419, 1423, 1608, 1622, 1643, 1738, 1767, 1768.

VISION.

1704. Infra-Red Radiation and Visual Function. M. Luckiesh and F. K. Moss. *J.O.S.A.* 27. *pp*. 69–71, *Feb*., 1937.—The light from a tungsten-filament lamp contains much more infra-red energy per lumen than does average daylight. The authors are concerned with determining whether this additional proportion of infra-red is deleterious to vision. The subject was required to read for 1 hr. (*a*) under an unfiltered illumination of 100 f.c. given by 150-W tungsten filament lamps, and (*b*) under the same illumination of light which had been filtered through 3 in. of water. The rate of blinking, the pupil diameter, the convergence reserve and the time to perform an acuity test were all determined before and after the hour's reading. The speed of reading was also measured. No significant difference in any of the tests was observed between the results for the two types of illumination. It is concluded that the presence of larger amounts of infra-red radiation in artificial light than in natural light is not a factor of importance in lighting practice. W. S. S.

See also Abstract 1643.

X-RAYS.

1705. X-Rays: Production of X-Rays. G. E. Bell. Absorption of X-Rays. I. Backhurst. Scattering of X-Rays. I. Backhurst. Ionisation in Gases. I. Backhurst. Energy Expended in Ionising Air. W. Binks. Absorption Spectra. G. Shearer. Crystal Structure of Metals and Inorganic Substances. W. A. Wood. Crystal Structure of Organic and Biological Substances. J. Thewlis. Radium. W. E. T. Perry. *Phys. Soc., Reports*, 3. *pp.* 338–368, 1936.—Progress review.

1706. Atomic Scattering Factor of Mercury. T. Derenzini. *N. Cimento*, 13. *pp.* 423–425, *Nov.*, 1936.—Value of the atomic scattering factor of Hg are calculated on the basis of the Hartree autofunctions. They do not differ very widely from those calculated by other methods. C. J. B. C.

1707. Scattering of X-Rays by Gaseous Alcohols. R. Ramsauer. *Zeits. f. phys. Chem.* 35. *Abt.B.* 2–3. *pp.* 139–162, 1937.—Measurements of the intensity of scattering of X-rays by gaseous alcohols in different directions lead to information regarding the molecular structures of the compounds involved. The C–O distance is found to be 1·46 Å and the electro-negative character of hydrogen in the aliphatic C–H bond is confirmed. The limits of the utility of this method in the investigation of the structure of organic molecules are discussed. J. T.

1708. L-Spectra of Iron above the Curie Point. S. S. Sidhu. *Indian Journ. Phys.* 10. *pp.* 421–428, *Dec.*, 1936.—The critical potentials of iron are investigated up to 132 V, at a temperature of 825° C., *i.e.*, above the Curie point. Care was taken to decide if breaks or changes of slope in the voltage-current curve were really associated with these critical potentials. The results are compared with Thomas's measurements below the Curie point, and are found to agree within the limits of experimental error. It is therefore apparent that the critical potentials involving L and M energy levels of Fe are independent of the magnetic state of the element. Hence the anomalies of the L and M level diagrams do not appear to be, as concluded by Chalklin, the result of magnetic phenomena. [See Abstract 3242 (1936).] C. J. B. C.

1709. K-Absorption Spectra of Copper. T. Hayasi. *Tohoku Univ., Sci. Reports*, 25. *pp.* 661–685, *Dec.*, 1936. *In German.*—Pure Cu shows three steps in the K-absorption spectrum; the longest-wave edge K_1, shortest K_2 and in between a faint edge K'. These are due to the electron-jumps $K - M_{IV,V}$; $K - N_1$; $K - N_{II,III}$ respectively. In the alloys Ni-Cu and α-brass the edge K_1 has the same wave-length as in pure Cu. An edge near to the position of K_2 alone appears in $CuCO_3$ and $CuSO_4NH_3$. In Cu_2O the edges are very similar to those in pure Cu, except that a new faint edge K'' appears on the short wave-length side of K_3. In CuO occurs a three-step edge, shorter in wave-length than those in Cu_2O, but longer in wave-length than those in $CuCO_3$ and $CuSO_4NH_3$. In β-brass, which is an inter-metallic compound, there is one edge, near to K_1. The observations show no direct correlation with the valence of the Cu. In the region of wave-lengths shorter than the Cu K-edges, a similar fine-structure occurs in pure Cu, NiCu, α-brass and another fine-structure shorter in wave-length than the Ni K-edges, which is similar in NiCu and in pure Ni. A. C. M.

1710. Non-Diagram Lines in the K-Spectra of Nickel and Copper. T. Hayasi. *Tohoku Univ., Sci. Reports,* 23. *pp.* 785–803, *Dec.,* 1936. *In German.*—Using a focussing X-ray spectrograph, several non-diagram lines are observed for the K-spectra of Ni and Cu. The measurements show that these lines are closely connected with the fine-structure of the K-absorption spectra, and quantitative relationships with absorption maxima are established. A. C. M.

1711. Intensity of Characteristic Radiation as a Function of Applied Voltage. J. A. Hill and H. Terrey. *Phil. Mag.* 23. *pp.* 339–344, *March,* 1937.—The intensities of the K radiations from Cu and Ag are investigated and it is found that the equation $I = K(V^2 - V_K^2)$ is the more correct form in these two cases. AUTHORS.

See also Abstracts 1417, 1421, 1429, 1723, 1838, 1842.

HEAT.

CALORIMETRY.

1712. Heat Capacity and Vapour Pressure of Solid and Liquid Ammonia. R. Overstreet and W. F. Giauque. *Am. Chem. Soc., J.* 59. *pp.* 254–259, *Feb.*, 1937.—The heat capacities of solid and liquid NH_3 are determined over their respective ranges from 15° K. to the boiling point. The melting and boiling points are found to be 195·36 and 239·68° K., respectively. The heat of fusion is 1351·6 cal./mol. The heat of vaporisation at the boiling point is 5581 cal./mol. The vapour pressure of solid and liquid NH_3 are measured and the data are represented by the equations: solid NH_3 176·92 to 195·36° K. $\log_{10}P$ (int. cm. Hg) $= 1630{\cdot}700/T + 9{\cdot}00593$; liquid NH_3 199·26 to 241·59° K. $\log_{10}P$ (int. cm. Hg) $= -1612{\cdot}500/T - 0{\cdot}012311\,T + 0{\cdot}000012521T^2 + 10{\cdot}83997$. The molal entropy of the gas at the boiling point is calculated by means of the third law of thermodynamics and the experimental data. The value found, 44·13 ± 10 e.u., is in excellent agreement with the value 44·10 e.u. calculated from spectroscopic data. From band spectrum data the entropy of NH_3 at 298·1° K. and 1 atmos. is calculated to be 45·91 cal./deg./mol. The above entropy value, which should be used in ordinary thermodynamic calculations, does not include the nuclear spin entropy. The absolute entropy is 52·22 cal./deg./mol. AUTHORS.

1713. Specific Heats of Vitreous Silica and Components of Glasses as Functions of Temperature. A. Thuret. *Soc. Glass Technol., J.* 20. *pp.* 680–684, *Dec.*, 1936.—The following formulæ are suggested for the average specific heat S_m from 0° to t°, and for the true specific heat S: $S_m = (at + S_0)/(bt + 1)$, $S = (abt^2 + 2at + S_0)/(bt + 1)^2$. These formulæ have been established for vitreous silica, lime and alumina in view of the fact that the largest number of measurements have been carried out on these substances by different authors. The values calculated in this way correspond very accurately to most of the values observed at the temperatures between − 273° and 2600°. AUTHOR.

See also Abstracts **1445, 1699, 1730, 1742.**

CONDUCTION.

1714. Thermal Conduction in Rarefied Cases. E. Fredlund. *Ann. d. Physik*, 28. 4. *pp.* 319–324, *Feb.*, 1937.—The thermal conduction in gases at low pressures is discussed from the point of view of Knudsen's theory of accommodation and Smoluchowski's definition of the temperature drop coefficient. By means of the relation $\lambda = \mu\pi\sqrt{2\pi}/4\sqrt{p\rho}$ where λ is the mean free path, μ the viscosity, p the pressure, and ρ the density, due to Meyer and Eucken's relation $\varkappa = KC_v\mu$, where $\varkappa$ is the thermal conductivity in distinction to the molecular conductivity, and C_v is the specific heat at constant volume, an expression is deduced for β, where β is defined by temperature drop coefficient $= \beta\lambda$. This is applied to a diatomic gas in the case of the parallel plate method and the hot-wire method. The results obtained are discussed briefly in the light of recent papers on this subject. E. H. D.

1715. Thermal Conductivity of Metals. F. Gabler. *Phys. Zeits.* 38. *pp.* 78–82, *Feb.* 1, 1937.—A rod of the metal concerned is heated

at both ends by means of suitable heating coils, and it can be further heated by passing an electric current through the specimen. The temperature is measured at the centre and at either end, and these are the boundary conditions for the solution of the appropriate differential equation. Taking the origin at the centre of the rod, this is given as $d^2\theta/dx^2 - 2a\theta/kr + 0\cdot239i^2\,\sigma/k = 0$ where θ is the temperature excess of the cross-section over the surrounding air temperature, a is the coefficient of heat transfer to the surrounding air, k the thermal conductivity of the metal, r its radius, i the current passing and σ the specific resistance of the metal. The equation is solved taking σ as a third degree polynomial in temperature, and a as a second degree polynomial in the temperature, giving the result as an elliptic integral. A suitable experimental set up is described and the results are given for Cu and a Ni alloy. Other points discussed are the determination of the coefficient a, the influence of radiation, the radial temperature distribution, etc. The results are for Cu $0\cdot915 \pm 0\cdot007$ and for a Ni alloy $0\cdot157 \pm 0\cdot002$ cal. cm^{-1}. sec^{-1}, $°\text{C}^{-1}$., at temperatures of 10–15° C. for Cu and 12–25° C. for the alloy.
E. H. D.

1716. Biot-Despretz Comparative Method for Thermal Conductivity Determinations. R. Weise. *Phys. Zeits.* 38. *pp.* 133–138, *March* 1, 1937.—It is shown that the method of Biot for the comparison of the thermal conductivities λ_1 and λ_2 of two metal rods of similar diameter is independent of the total heat loss from the rods (convection + radiation), provided this loss is the same function of the temperature in both cases. The solution of the differential equation for a single rod, heated at one end and losing heat to the surroundings by convection and radiation, is obtained. Assuming that the emissivity is known, and that the convection loss varies with the temperature in the manner suggested by Jodlbauer, the solution can be used for a direct determination of the thermal conductivity.
R. W. P.

See also Abstracts 1519, 1730, 1788.

CONVECTION.

1717. Instability of a Thin Layer of Fluid Heated from Below. S. L. Malurkar and M. P. Srivastava. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 34–36, *Jan.*, 1937.—Jeffreys [see Abstract 1467 (1928)] obtained a solution for the 6th-order differential equation of the form $(d^2/dx^2 - a^2)^3y = -\lambda a^2y$, representing the motion of a thin layer of fluid heated from below, by assuming a sine series for d^6y/dx^6. A general but direct method is now applied to obtain a solution of the differential equation.
R. W. P.

1718. Electro-Convective Cellular Vortices. D. Avsec and M. Luntz. *Comptes Rendus*, 204. *pp.* 420–422, *Feb.* 8, 1937.—Experimental methods for the production of electro-convective cellular vortices [see Abstract 757 (1937)] in a horizontal layer of oil from 2 to 30 mm. thick are described. The required electric field is produced by a Wimshurst machine giving 200 to 300 μA at 100 kV. Photographs are reproduced showing the appearance of the surface for two thicknesses of fluid, and a comparison is made between the vortices produced by this method and those produced thermally. In the electroconvective case the observed movements are about ten times as rapid, the surface is more disturbed and vortices can be set up in which the fluid circulates in both directions.
R. W. P.

1719. Alternating Thermo-Convective Cellular Vortices in a Thin Layer. M. Luntz. *Comptes Rendus*, 204. *pp.* 547–549, *Feb.* 22, 1937.—The fluid in which these vortices are observed consists of a layer of oil 10 cm. thick and 50 cm. long retained between parallel vertical glass walls 1·5 cm. apart. The lower surface of the oil floats on hot water and the upper surface is in contact with cooler air. The fluid, as seen through the glass walls, appears to be divided into a number of uniform rectangles by vortices of uniform height but alternating in direction of movement. The layer is too wide for surface tension to be effective in the production of these vortices, as has been suggested to explain the somewhat similar motions observed on the inclined sides of vessels containing warm liquids, and increase in width has little influence until a width comparable with the height is reached, when the vortices change, the axes becoming parallel to the sides. R. W. P.

1720. Thermo-Convective Cellular Vortices in Superimposed Layers. D. Avsec. *Comptes Rendus*, 204. *pp.* 549–551, *Feb.* 22, 1937.—The theory of A. R. Low indicated the possibility of a number of superimposed layers of cellular vortices being formed in a fluid when heated from below. Such layers of vortices cannot be observed in a homogeneous fluid, but should be set up in layers of liquids which do not mix. The present author used the vessel described in the previous abstract arranged in a vertical position. It had at the bottom warm water covered with a film of oil to prevent evaporation. A layer of tobacco smoke floated above this surface and was readily discernible from the upper clear air. Thermo-convective cellular vortices were observed to be set up in the smoke-layer, and wisps of smoke showed the air-layer above it to be in similar motion. R. W. P.

1721. Heat and Material Transfer under Large Temperature and Partial Pressure Differences. G. Ackermann. *Forsch. IngWes.* 8. *V.D.I. Forschungsheft No.* 382. *pp.* 1–16, *Jan.–Feb.*, 1937.—For such processes as evaporation in which both heat and material transfer takes place the principle of similitude can be applied to obtain closely analogous expressions for the quantities which are transferred. When, however, the partial pressure differences are large these are no longer exact. The differences in mass, and the establishment of either a permeable or semi-permeable bounding surface modify the material transfer, whilst for the heat transfer, allowance has to be made for the heat capacity of the transferred material. Assuming a simple Prandtl boundary layer theory, a detailed analysis is made to determine the necessary modifications introduced in the transfer coefficients when allowance is made for these effects. New expressions are thus derived for the ratio of the heat to the material transfer coefficients. Numerical examples are given showing the difference between the results obtained by the new and the earlier similitude theories. The analysis is applied to derive an exact equation connecting vapour pressures with the difference between the wet- and dry-bulb readings of an Assmann psychrometer, and to determine the surface temperature of glowing carbon in a forced air stream. R. W. P.

See also Abstract 1730.

DILATATION.

1722. Anomaly of Expansion in Pt-Fe Alloys. A. Kussmann. *Phys. Zeits.* 38. *pp.* 41–42, *Jan.* 15, 1937. *From the Reichsanstalt.*—Reference is made to the anomalies of expansion found in Fe-Ni and

Fe-Co-Cu alloys. The Fe-Pt alloys which contain 50 to 60 % by weight of Pt have a coefficient of expansion which varies from a low positive value to a minimum of -6×10^{-6} at about 55 % Pt content, thereafter increasing through zero. The drop in the coefficient from normal occurs over the range between 20 % and 70 % Pt. G. E. A.

1723. X-Ray Investigation of Pure Iron-Nickel Alloys. Part II. Thermal Expansion of Further Alloys. E. A. Owen and E. L. Yates. *Phys. Soc., Proc.* 49. *pp.* 178–188, *March* 1, 1937.—The lattice parameters of three Fe-Ni alloys containing respectively 41·1, 32·2 and 24·2 % of Ni by weight are measured at different temperatures. The alloys had to be carefully heat-treated before any spectra could be obtained with them. From the relations between parameter-value and temperature, curves are obtained showing how the coefficient of thermal expansion varies with temperature. The two alloys containing 41·1 and 32·2 % of Ni yield curves which show that the coefficient of thermal expansion has a somewhat low value at low temperatures. At a particular temperature the value increases suddenly to another value, which on further rise of temperature remains almost constant. These results are in agreement with the results obtained by other observers by other methods. The expansion curve of an alloy containing 24·2 % of Ni shows the ordinary thermal-hysteresis effect found with the irreversible alloys. The thermal expansion of the components α and γ are measured. The mean atomic volume in the α phase is greater than the mean atomic volume in the γ phase at the same temperature. By the aid of these measurements it is possible to explain the form of the expansion curve obtained with a rod of the material, which shows a contraction when the α phase transforms to the γ phase. Values are given for the lattice parameters of the pure α and γ phases at different temperatures. The coefficient of expansion of the body-centred α phase is $8{\cdot}2 \times 10^{-6}$ *ca.* at 0° C. and $14{\cdot}0 \times 10^{-6}$ at 200° C., and that of the face-centred γ and γ' phases is $17{\cdot}5 \times 10^{-6}$ between 0° C. and 630° C. [For Part I see Abstract 760 (1937)]. AUTHORS.

See also Abstract 1730.

MELTING AND BOILING POINTS.

***1724. Efficiency of Packings for Laboratory Distilling Columns. M. J. Marshall, F. Walker and D. H. Baker.** *Canad. J. of Research,* 15. *Sect.B. pp.* 1–6, *Jan.,* 1937.—The efficiency of jack chain packings, with alcohol-water mixtures, increases by only 13·2 % with decrease in the size of the chain links from No. 18 to No. 22, while a drop in capacity of 36·7 % is noted. If all factors are taken into consideration, No. 18 jack chain is the most desirable of those studied. The efficiency of Lessing rings, 0·22 in. in dia., is higher than that of any of the chains studied, but the capacity is much less than that of No. 18 chain, and only slightly better than that of No. 22 chain. AUTHORS.

1725. Protecting Films of Vapour in Vacuum-Evaporation. G. Schmid and H. Speidel. *Zeits. f. Elektrochem.* 43. *pp.* 187–192, *March,* 1937.—The vapour films occurring at the interface between water and a metal surface at temperatures between 20° C. and 100° C. are studied at reduced pressures. The temperature and pressure conditions under which the vapour films are most stable are determined, and thickness measurements made by a capacity method show that the thinnest films are also the most stable. The importance of the results with regard to corrosion-prevention and heat-transfer problems is emphasised. It is stated that the film thickness is given by the empirical formula $d = 1 \cdot 45 \lambda (t_m - t_s) \times 10^7/p(t_s - t_w)$, where d is the thickness in μ, λ is the thermal conductivity of water-vapour at t_s the boiling point of water at the pressure p (in mm. of Hg), and t_m and t_w are the metal and water-temperatures respectively. A. G. Q.

See also Abstracts 1424, 1721, 1726, 1730.

TEMPERATURE, MEASUREMENT OF.

✱**1726. Absolute Temperature Scale. Part II. J. A. Beattie, M. Benedict and B. E. Blaisdell. Part III. J. A. Beattie and B. E. Blaisdell. Part IV. J. A. Beattie, B. E. Blaisdell and J. Kaminsky.** *Am. Acad., Proc.* 71. 6–8. *pp.* 327–385, *Jan.*, 1937.—For Part I of this paper see Abstract 1590 (1931). In Part II the equation of the international temperature scale giving the boiling point of S in terms of the vapour pressure is discussed, together with the prescribed methods for the fixed point determinations. An account is then given of a series of experiments carried out to test the validity of the international equation. The apparatus is described in detail under the headings, thermometry, comparator and scale, barometer, manostat, boiling apparatus, protection tube, shields, and sulphur. The handling of the experimental results is given completely, together with a discussion of the many corrections which have to be applied to the observed values to give the true values. The equation is given as $t_p = 444 \cdot 6 + 0 \cdot 0908028\ (p-760) - 0 \cdot 000047573\ (p-760)^2 + 0 \cdot 00000004361\ (p-760)^3$, where t_p° C. (Int.) is the temperature of equilibrium between liquid S and its vapour at a pressure of p standard mm. of Hg. This holds over the range 660 to 860 mm. of Hg. Part III deals with the investigation of the steam point, and all the above applies, where suitable. The results obtained using an open and a closed hypsometer are compared, the latter being the more suitable as far as reproducibility is concerned. The equation derived is $t_p = 100 + 0 \cdot 0368578\ (p-760) - 0 \cdot 000020159\ (p-760)^2 + 0 \cdot 00000001621\ (p-760)^3$. Part IV considers the use of the Hg boiling point as a fixed point for the range of temperatures above the ice point, but well below the S point. Full details of the apparatus and results are given and the equation deduced is $t_p = 356 \cdot 580 + 0 \cdot 0730951\ (p-760) - 0 \cdot 000039866\ (p-760)^2 + 0 \cdot 00000003191\ (p-760)^3$, where t_p (°C. Int.) is the temperature of equilibrium between Hg and its saturated vapour at a pressure p standard mm. E. H. D.

✱**1727. Radiation Thermopiles of Quick Response. R. V. Jones.** *Journ. Sci. Instruments*, 14. *pp.* 83–89, *March*, 1937.—The method of Wilson and Epps [see Abstract 303 (1921)] has been applied in an improved form to the construction of fast radiation thermopiles. The design is discussed, and an easy technique described. The fastest instruments reached 99 % response in 0·08 sec., their sensitivity and other characteristics being similar to the Moll air-operated piles. AUTHOR.

✱**1728. Measurement of High Temperatures. K. Guthmann.** *Arch. f. Wärmewirtsch.* 15. *pp.* 49–52, *Feb.*, 1937.—An optical pyrometer is described which has been designed for the measurement of high temperatures in cases where uncertainty as to the emissivity renders the disappearing filament pyrometer unsuitable. Light from the source enters a telescope and passes through a bichromatic colour wedge and an adjustable neutral wedge. The former transmits complementary red and green colours and a yellowish white field of variable intensity is obtained. The inclusion of a half-silvered mirror enables this to be compared with light from a lamp

supplied by an adjustable current. The instrument measures both the colour temperature and a second temperature which is close to the black-body temperature. From their difference the emissivity and thus the true temperature can be derived. Observations made with this colour pyrometer are compared with those of thermocouples and disappearing filament pyrometers, and a number of applications of the new instrument for the measurement of various industrial temperatures are described.
R. W. P.

***1729. Constant Temperature Gas-Regulated Water-Bath. J. L. Parkinson.** *Journ. Sci. Instruments,* 14. *pp.* 94–96, *March,* 1937.—A water-bath is described which maintains a temperature constant to ± 0·001° C. It is suitable for working at any temperature about 3° C. above its surroundings. It has proved to be of great use in physiological experiments and particularly for the measurement of vapour pressures by thermoelectric methods. AUTHOR.

1730. Heat. R. W. Powell. *Phys. Soc., Reports,* 3. *pp.* 143–174, 1936.—Progress review.

1731. Direct Images of Temperature Fields by the Use of Lenard Phosphors. P. Neubert. *A.T.M. No.* 67. *T3, Jan.,* 1937.—A technique is described making use of the quenching effect of infra-red radiations on phosphorescence. The hot body is imaged on the phosphor by a lens, the darkening effect then being used to give a picture of the temperature field of the body. A quantitative measurement of the decay with a photo-cell can be used as a measure of the temperature of the hot body. Putting the quenched phosphor plate in contact with a green sensitive plate (using ZnS phosphor) gives a permanent picture of the hot body—a modification of infra-red photography. This last technique will be the subject of a further paper. J. E.

THERMOCHEMISTRY.

1732. Partial Molal Heat Content of Aqueous Zinc Sulphate. H. S. Harned. *Am. Chem. Soc., J.* 59. *pp.* 360–361, *Feb.,* 1937.—By employing a quadratic equation to express the e.m.f. data of the cell Zn (2-phase amalgam) | $ZnSO_4(m)$ | $PbSO_4$-Pb (2-phase amalgam) from 0 to 37·5° with the omission of an uncertain result at 50°, values of the relative partial molal heat content of $ZnSO_4$ were computed. These values are in agreement with those obtained by measurements of heats of dilution, a fact which seems to justify our method of procedure. We may conclude that from 0 to 37·5° the e.m.f. data possess a high accuracy which we judge to be of the order of ± 0·05 mV. If the method here employed is correct, the previous discrepancy between the values of $\bar{L}_2$ obtained from heat data and e.m.f. measurements disappears. This agreement is excellent evidence for Cowperthwaite and La Mer's extrapolation of the e.m.f.s, and lends confirmation to their proof of the effect of the extended terms of the Debye and Hückel theory. AUTHOR.

1733. Heats of Combustion and Refraction Data of Pentenoic Esters. E. Schjånberg. *Zeits. f. phys. Chem.* 178. *Abt.A.* 4. *pp.* 274–281, 1937.—Continuing previous work [see Abstract 1757 (1936)] the author determines the heats of combustion and molecular refractions (using D, H_α, H_β and H_γ lines) of the ethyl, propyl, butyl, isobutyl, secondary propyl and secondary butyl esters of valeric, allyl acetic, β-ethylidenepropionic and propylideneacetic acids. Heats of formation and the refraction and dispersion increments are calculated for the C = C link and constitutive effects are discussed. L. A. W.

1734. Lower Limit of Inflammation in Oxyhydrogen Gas. Natalie Semenova. *Acta Physicochimica*, 6. 1. *pp.* 25–42, 1937. *In English.*—The surface of the pyrex vessels was treated by a special method, so that very low and quite consistent values could be obtained for the lower ignition limit in mixtures of O_2 and H_2. With diameters of 15 cm. and more, the relationship pd = const. has been shown to be accurate to within 2·5 %; with smaller diameters, the product becomes somewhat less, *e.g.*, 15 to 25 % less, if the diameter is 6 mm. In full agreement with the theory, the relation between pressure and temperature can be expressed by the equation $p/\mathrm{T} \doteq ae^{+\mathrm{E}/\mathrm{RT}}$, where E = 11,000 cal. AUTHOR.

1735. Ignition Limit of Gaseous Mixtures. P. P. Pirotzky. *Acta Physicochimica*, 6. 1. *pp.* 131–136, 1937. *In English.*—Experiments are carried out to determine the minimum current i necessary for the ignition of a certain methane-air mixture by electric sparks caused by the breaking of a d.c. circuit. The dependence of i upon the self-inductance L is found to be $\mathrm{L}i^4$ = constant, the voltages used being 70 and 110 V and the values of L ranging from $\frac{1}{2}$ to 4 henries. This result is not in agreement with that of previous workers who have put forward the relation $\frac{1}{2}\mathrm{L}i^2$ = constant. The present result throws doubt upon the suggestion that the energy of the magnetic field plays a predominant part in the ignition of gaseous mixtures by break sparks in inductive circuits. L. A. W.

1736. Catalytic Combustion of Formaldehyde on a Platinum Wire. W. Davies and R. Spence. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 300–304, *Jan.*, 1937.—The combustion of different mixtures of formaldehyde and air on a Pt wire has been studied. In the case of the weak mixtures, the rate of heating of the wire is proportional to the formaldehyde concentration. When the formaldehyde concentration lies between 20 and 65 %, explosion occurs after inception of the surface reaction. The results for the rich mixtures are complicated by the simultaneous occurrence of homogeneous oxidation, but when the formaldehyde concentration reaches 85 %, the heterogeneous reaction is suppressed. It is suggested that the presence of adsorbed oxygen is an essential condition for the occurrence of surface combustion. AUTHORS.

1737. Catalytic Combustion of Acetylene. W. Davies. *Phil. Mag.* 23. *pp.* 409–425, *March*, 1937.—The experiments were carried out by means of a method which involves the observation of the temperatures attained by thin metallic wires when they are heated by an electric current and by catalytic combustion simultaneously in an atmosphere containing the reacting gases [see Abstract 4246 (1934)]. The results are briefly as follows: Acetylene and Air.—The temperature at which the reaction starts is not affected by the concentration of the acetylene; the rates of combustion are not greatly affected by raising the temperature after the reaction has started; the rate of combustion at any given temperature is proportional to the concentration of the acetylene. Acetylene and Oxygen.—The only change is a lowering of the temperature at which the reaction starts. Acetylene, Air and Hydrogen.—The initiation temperature with hydrogen and air is lower than that for acetylene and air, and when both gases are present the initiation temperature is practically the same as for acetylene alone, but it is shown that both the reactions then occur simultaneously. Similar results are obtained with acetylene, methane, and air. Pt was used in all these experiments, and no analogous results were obtained with Au, Ag, Cu and Fe, but Ni shows some catalytic activity with air and acetylene. These results are discussed in the light of other work on the subject. E. H. D.

1738. Photographs of Phenomena Accompanying Detonation. A. Michel-Lévy and H. Muraour. *Comptes Rendus*, 204. *pp.* 576–579, *Feb.* 22, 1937.—The authors' views as to the cause of the chief luminosity in explosions of this character [see Abstract 238 (1936)] are confirmed by a series of photographs (reproduced) of explosions of the mixture $3C(NO_2)_4 + C_7H_8$ taken at intervals of $0{\cdot}5$–16×10^{-5} sec. C. A. S.

THERMODYNAMICS.

1739. Equation of State and Saturation Curve. P. Centner. *Assoc. Ing. El. Liège, Bull.* 16. *pp.* 265–274, *Oct.*, 300–314, *Nov.*, *and pp.* 329–350, *Dec.*, 1936.—Following a detailed discussion of the van der Waals equation a new and improved equation of state is derived, which is based on the existence of a repulsive force between molecules inversely proportional to the 5th power of their distance apart. The new equation is $\pi - 7\tau/\phi = 7/\phi^{4/3} + 1/\phi^{7/3}$, where π, ϕ and τ are the reduced pressure, volume and temperature respectively. It leads to the differential equations for the saturation curve: $d\pi/d\phi = (\pi' - \pi)\,(1 + \log\phi)/\phi\log\phi$ and $d\tau/d\phi = (\tau' - \tau)/\phi\log\phi$, and these allow a relation to be established between the three states of a substance. Whereas other formulæ have not been applicable to the solid state, this shows the existence of a so-called cryocritical point corresponding to a volume given by $\phi = 0{\cdot}3675$. The value for water at 0° C. agrees with this to within about 6 %. R. W. P.

1740. Definition of Homogeneous Fluids Thermodynamically Possible. J. Villey. *J. de Physique et le Radium*, 8. *pp.* 57–58, *Feb.*, 1937.—The author contends that what he calls the surface of state of a fluid, $p = F(v, T)$, is commonly and wrongly introduced into thermodynamic theory under the term characteristic surface; the equation does not characterise a fluid. Two characteristic surfaces should be employed to characterise a fluid: (1) the characteristic mechanical surface, $p(v, T)$, and the characteristic calorimetric surface $S(v, T)$. The two are not independent. The one or other can be employed to define a homogeneous fluid, thermodynamically possible, *a priori*, and the conditions imposed by the first surface upon the second are exactly reversible in character. J. S. G. T.

1741. Thermodynamic Treatment of Unsharp Phase Transformations. A. J. Rutgers and S. A. Wouthuysen. *Physica*, 4. *pp.* 235–244, *March*, 1937. *In German.*—The phase transformation considered is that in which the specific heat and the expansion coefficient does not suddenly step from one value to another, but, within a finite temperature range, rises to a maximum before reaching the value appropriate to the new phase. In order to treat such a phase transformation thermodynamically a fictitious transformation temperature T_s is assumed as well as fictitious entropy functions S_α and S_β, thermodynamic potentials Z_α and Z_β, and two suitable functions of the fictitious specific volumes v_α and v_β. Two points infinitely close together, but on opposite sides of the imaginary transition curve, are considered which show a discontinuity in S_α and v_β, and it is shown that equality of the fictitious thermodynamic potentials holds for these two points. By differentiation equations are obtained which are closely analogous to the recognised equations (Clapeyron, etc.) for sharp phase transformations. Application of the method to the liquid helium transformation gives results in agreement with experiment. R. W. P.

1742. Heat Capacity, Heat of Fusion and Heat of Vaporisation of Ethane. R. K. Witt and J. D. Kemp. *Am. Chem. Soc., J.* 59. *pp.* 273–276, *Feb.*, 1937.—The heat capacity of solid and liquid ethane is measured from 15° K. to the boiling point. The melting point of ethane is determined to be 89·87 ± 0·1° K. The heat of fusion of ethane is found to be 682·9 cal./mol. The heat of vaporisation of ethane at the boiling point is found to be 3514 cal./mol. The entropy of ethane gas at the boiling point calculated from the above data is 49·54 e.u. The entropy at 298·1° K. is 54·85 e.u. AUTHORS.

1743. Entropy of Ethane and the Third Law of Thermodynamics. J. D. Kemp and K. S. Pitzer. *Am. Chem. Soc., J.* 59. *pp.* 276–279, *Feb.*, 1937.—The entropy of ethane is calculated from the heat and free energy of hydrogenation of C_2H_4 considering C_2H_6 as a restricted internal rotator. A comparison of the values so obtained, with the entropy obtained from calorimetric measurements extending to low temperatures by use of the third law of thermodynamics, proves the correctness of the third law value. Very strong evidence is presented for the existence of a potential barrier of about 3150 cal./mol. restricting the internal rotation of the methyl groups in ethane by the comparison of the experimental values of the entropy of ethane with values obtained from statistical mechanical calculations. It is believed that the discrepancies noted by some authors in the cases of other hydrocarbons are due to the assumption of incorrect molecular models involving free internal rotation of the methyl groups. From a knowledge of the correctness of the third law entropies in the cases of NH_3, H_2S, CH_4 and C_2H_6, it may be stated that very probably no molecules other than D_2 and H_2 will have any residual entropy due to the persistence of rotation in the crystal at temperatures below 10° K. AUTHORS.

1744. Thermodynamic Processes Originating from Changes of Work Content. E. Lange. *Zeits. f. Elektrochem.* 43. *pp.* 158–174, *March*, 1937.—The theory of thermodynamic processes is developed from the point of view of changes in work content. F. J. B.

1745. Thermodynamic Variables in Chemical Kinetics. E. A. Moelwyn-Hughes. *Faraday Soc., Trans.* 32. *pp.* 1723–1738, *Dec.*, 1936.—When the kinetic order of chemical change does not coincide with, but is lower than, the stoichiometric order, the observed velocity constant must be a composite quantity, involving either simultaneous or consecutive changes, so that the Arrhenius equation can no longer have the relatively simple meaning as for elementary processes. In the present paper, the author first discusses experimental and theoretical approaches to the study of intermediate complexes, following which the entropy of activation and the frequency of binary collisions in solution are considered ; a method is then proposed for determining the entropy of activation. The influence of pressure on the kinetics of reactions in solution is next examined, and finally a reformulation of the methods of introducing thermodynamic variables into expressions for reaction velocity constants is given. The last named study yields information concerning the properties of active molecules, other than the energies and volumes, with which Arrhenius and van't Hoff were primarily concerned. H. H. Ho.

1746. Thermodynamic Variables in Reaction Kinetics. M. C. Evans and M. Polanyi. *Faraday Soc., Trans.* 33. *pp.* 448–452, *March*, 1937.

1747. Elastic Thermal Waves in Liquids. R. Lucas. *Comptes Rendus*, 204. *pp.* 418–420, *Feb.* 8, 1937.—Debye has shown that the thermal agitation of the atoms of solids and liquids can result from the superposition of well diffused elastic waves, and an experiment is now described which is considered to demonstrate the existence of a pressure of radiation due to such waves. A hollow glass tube (5 cm. dia. and 5 cm. high) with metal end plates is hung from a balance and immersed in the liquid, the ends being horizontal. Equilibrium is established with the liquid at a uniform temperature, and on cooling the base of the liquid the cylinder is first dragged downwards, but later rises owing to the density of the liquid increasing as the temperature falls. It is considered that convectional effects are absent, and that this initial downward movement is due to the greater pressure of radiation on the upper end at the higher temperature. For a 10° C. difference in water the measured force is about 0·008 gm. The effect is not observed when the glass tube is replaced by massive metal, owing presumably to thermal conduction reducing the temperature difference. R. W. P.

See also Abstracts 1712, 1730, 1750, 1785, 1805.

VAPOUR PRESSURE.

1748. Vapour Pressure of Gaseous Hydrocarbons at Low Temperatures. R. Delaplace. *Comptes Rendus*, 204. *pp.* 493–495, *Feb.* 15, 1937.—Utilising a similar method [see Abstract 1268 (1937)] for regulating temperature, the vapour pressures of C_2H_6, C_3H_8, *n*- and iso-butane, C_2H_4, propylene, *n*- and iso-butylene, and C_2H_2 have been determined for each degree above − 196° for which they are measurable and ≯ 150 mm. Hg. C. A. S.

1749. Vapour Pressure of Commercial High-Boiling Organic Solvents. G. S. Gardner and J. E. Brewer. *Indust. and Eng. Chem.* 29. *pp.* 179–181, *Feb.*, 1937.—Vapour pressure curves are determined for 11 samples of commercial high-boiling solvents, carbitol, butyl carbitol, dimethyl phthalate, dibutyl phthalate, terpineol, terpenyl acetate, benzyl alcohol, benzyl acetate, hexalin, tetralin and decalin, covering the region 20° to 150° C. The determined values are in agreement with data given in the chemical literature, in the few cases where such data are available. AUTHORS.

1750. Dissociation Pressure of a Solid Under Inert Gas Pressure. A. J. Perkins. *J. Chem. Phys.* 5. *pp.* 180–185, *March*, 1937.—The mole fraction of NH_3 in equilibrium with barium chloride octammine at 32° C. and at various pressures of He, A and N_2 is determined. At every pressure, the mole fraction is greater than that expected by a simple application of the Poynting relation. An equation is derived for the chemical potential of a component of a gaseous mixture in terms of the total pressure, the mole fraction, and the second virial coefficients. This equation is tested and shown to give fair agreement between calculated and observed values. One advantage is the fact that it can be used to calculate the mole fraction of the component of a gas mixture which arises from the dissociation of a solid with which the mixture is in equilibrium. It is also shown how these measurements might be used to calculate the second virial coefficients of gaseous mixtures. AUTHORS.

See also Abstracts 1712, 1721, 1796.

ACOUSTICS.

1751. Effect of Finite Breadth of Hammer Striking a Pianoforte String. D. Basu. *Calcutta Math. Soc., Bull.* **28.** *pp.* 187–192, *Sept.–Dec.,* 1936.—The hammer is supposed to have its plane surface facing the string, and the part of the string in contact with the hammer to move parallel to itself. An approximate solution is found for the equation of motion of the string, and it is shown that the finite breadth of the hammer has an effect on the duration of contact and on the maximum displacement. [See also Abstract 1663 (1934).] G. E. A.

1752. Sound. E. G. Richardson. *Phys. Soc., Reports,* **3.** *pp.* 106–129, 1936.—Progress review.

1753. H.F. Oscillations and Supersonic Waves. L. Bergmann. *Naturwiss.* **25.** *pp.* 113–119, *Feb.* 19, 1937.—Review of methods of production, properties and applications of supersonic waves. Nickel rods magnetically excited, and more often quartz plates piezoelectrically excited, are the usual sources of supersonic energy. The waves propagated in liquids have on light transmitted at right angles to their direction of propagation the effect of ruled gratings, and give rise to diffraction spectra. This optical effect and others are applied to the measurement of the length of supersonic waves in gases, liquids and solids; this measurement is equivalent to that of the velocity of propagation or of the adiabatic compressibility. With vibrating crystals, visible spectra analogous to the Laue X-ray figures are obtained, from which the elastic constants can be evaluated. Other applications include fine division of powders and colloids suspended in liquids, oxidation of liquids, expulsion of gases from metals in smelting, and biological and medical processes. P. V.

1754. Absorption and Diffusion of Ultrasonic Waves and the Structure of Liquids. R. Lucas. *J. de Physique et le Radium,* **8.** *pp.* 41–48, *Feb.,* 1937.—Experimental study of elastic ultrasonic waves in liquids has made it evident that the absorption of the waves is notably greater than that required by the theories of Stokes and Kirchhoff. In Stokes' theory, absorption due to viscosity is the most important term, and the liquid has a perfectly homogeneous structure. Experiment shows that elastic heterogeneity of the medium plays an important part in determining the magnitude of the absorption, and that it is independent of the viscosity. Also liquids are, elastically, turbid media and are capable of diffusing elastic waves. A table of values of absorption coefficients (due to viscosity) is given for several liquids, and a theory of diffusion of elastic waves is developed. The theoretical values are of a much smaller order of magnitude than the observed values. A conception of the liquid state as one with a subcrystalline molecular organisation seems to be needed to explain the magnitude of the absorption and diffusion of elastic waves. G. E. A.

1755. Velocity and Absorption of Sound at Ordinary and Low Temperatures. A. van Itterbeek and P. Mariëns. *Physica,* **4.** *pp.* 207–215, *March,* 1937. *In English.*—Experiments with ultrasonics are made on the velocity and absorption of sound in O_2, N_2 and H_2 at ordinary and low temperatures. The influence of a magnetic field perpendicular to the direction of propagation on the velocity and the absorption of sound in O_2 is studied. No influence is found on the velocity: the absorption, however, seems to undergo a decrease. At low temperatures, measurements are made at the boiling point of O_2. The dependence of the velocity and absorption of sound in O_2, N_2 and H_2 on pressure is studied. Concerning the velocity in O_2 and N_2, a good agreement with the Leiden measurements is found. The dependence on pressure, found for the absorption coefficient of O_2 and N_2, corresponds fairly well with the classical theoretical absorption. The values, found for the absorption coefficient of H_2 show that at the boiling point of O_2 there is still a dispersion effect. AUTHORS.

1756. Smoke Method of Measuring Supersonic Velocities. R. C. Parker. *Phys. Soc., Proc.* 49. *pp.* 95–104, *March* 1, 1937.—In view of certain criticisms brought against it, the smoke method used by Pearson [see Abstract 403 (1935)] has been further investigated. Various possible sources of error have been eliminated, and measurements of the velocity of sound have been made in air, O_2 and N_2 in the frequency range 92·2 to 801·7 kc./sec. The results are believed to be correct to within 1 part in 3000, and no evidence of dispersion in this range has been found. An explanation is given for Pearson's results. AUTHOR.

1757. Psychophysics of Hearing. Monaural and Binaural Differential Sensitivity and Exposure-Time. M. Upton and A. H. Holway. *Nat. Acad. Sci., Proc.* 23. *pp.* 29–34, *Jan.*, 1937.—Observations are recorded which demonstrate that differential sensitivity to acoustic intensities varies with the time of exposure of the ear to the sound. The observer was given a sound of intensity I (three values) for seven intervals of time varying from 1 to 120 sec., and his monaural values for ΔI (just noticeable increment in intensity) were measured for each ear for the different levels of intensity. ΔI varies directly with I and inversely with time t according to an equation of the form: $\log(1/\Delta I) = K \log t + C$, where K and C are constants. In the second part binaural effects are given, similar results having been found. The differential sensitivity (1/ΔI) increases with time of exposure, and is greater for binaural than for monaural stimulation. G. E. A.

1758. Border Problems of Physical and Physiological Acoustics. F. Trendelenburg. *Naturwiss.* 25. *pp.* 49–59, *Jan.* 22, 1937.—A review of the position reached by research in acoustics. Objective analysis of sounds may now be performed automatically in a few minutes by the method developed by Grützmacher and E. Meyer in which a search tone is varied over a wide range of frequency. When the search tone coincides with a partial tone, a galvanometer in the analysing set is deflected, the deflection being recorded on sensitive paper. Spectra are given for flute, violin, trombone, triangle, piano and small drum. Backhaus has shown that different instruments begin to sound in different intervals of time. Sounds which change rapidly have been analysed by an electrical method due to the author and E. Franz. The sound is received in a microphone, conveyed to an amplifier and passed through sound filters to be recorded. The filters pass frequencies in octave intervals, namely 100–200, 200–400, up to 6400. An oscillogram is recorded of these parts and the sound itself. By this method it is shown that in the organ the flue pipe is slower in attack than the reed pipe. The material of a previous paper [see Abstract 796 (1937)] is expanded and illustrated, and oscillograms of speech are also given. The paper touches on many other problems. G. E. A.

V.4
193

1759. Response of the Mammalian Cochlea to Phase-Reversal in a Continuous Musical Tone. C. S. Hallpike, H. Hartridge and A. F. Rawdon-Smith. *Phys. Soc., Proc.* **49.** *pp.* **190–193,** *March* **1, 1937.**—By means of a photo-cell, light source and interrupter, it has been found possible to produce phase-reversals in a musical tone of approximately sinusoidal wave-form. When this tone is caused to fall on the human ear, phase-change beats are heard as has previously been described [see Abstract 792 (1936)]. When this tone is caused to fall on the ear of a decerebrate cat, and its auditory-tract responses are recorded by means of a kathode-ray oscillograph, a temporary and marked decrease in amplitude of the response occurs, corresponding to each phase-change. This decrease is amplitude corresponds to the phase-change beat which is heard by the human subject and is postulated on the resonance theory of hearing. When the cochlear (Wever-Bray) response of the cat is similarly recorded, the response exhibits no such fall in amplitude in correspondence with the phase-change, which is moreover reproduced with marked fidelity. The cochlear response must therefore originate in some non-resonant structure. [See following Abstract.] AUTHORS.

1760. Phase-Change and Hearing. L. Hartshorn. *Phys. Soc., Proc.* **49.** *pp.* **194–197,** *March* **1, 1937.**—A circuit is described whereby the voltage applied to any instrument may be instantaneously reversed in phase without change of amplitude. The effects on various loud-speakers, a vibration-galvanometer tuned near to resonance, and a kathode-ray oscillograph are observed, and considered in relation to the experiments of Hartridge and co-workers. [See preceding Abstract.] L. H.

1761. Measurement of Noise. G. W. C. Kaye. *Phys. Soc., Reports,* **3.** *pp.* **130–142, 1936.**—Progress review.

1762. Acoustic Absorption. H. Lauffer. *Hochfrequenztechn. u. Elektroakustik,* **49.** *pp.* **9–20,** *Jan.,* **1937.**—It has been observed that acoustic absorption in enclosures is not entirely due to the reflection on surfaces which differ in acoustic impedance from that of the contacting air, and irregularities in the period of reverberation with frequency have revealed considerable absorption on account of motion of the walls which dissipate energy when vibrating. The author investigates the resonant properties of millboard panels. A sound of constant intensity but varying frequency over the audio range is applied, and the oscillation amplitude measured with a dynamic microphone fitted with a contact needle. The results are compared with the oscillatory decay obtained when the panel is struck inpulsively. The variation of damping with frequency is thus obtained. The effect on the reverberation period in an experimental chamber is then examined, with deductions for controlling the frequency trend of this period. L. E. C. H.

See also Abstracts 1500, 1578, 1763, 1848.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

1763. Bridge Circuit for Determination of Harmonic Content. H. E. Linckh. *Phys. Zeits.* 38. *pp.* 105–111, *Feb.* 15, 1937. *From the Reichsanstalt.*—The description is given of a new bridge circuit by which harmonic contents of only 1 % may be determined with an accuracy of better than 1 %. One arm of the bridge is tuned to the frequency of the fundamental and the indicating instrument, consisting of a metal rectifier and a moving-coil instrument, records the arithmetic mean of the bridge voltage which is that of the harmonics alone. To measure the peak voltage a thyratron is used, the bridge voltage being applied to the grid of the valve. The values obtained by the thyratron and by measurements of oscillograph records differ in some cases by 0·2 % of the peak voltage of the fundamental. L. E.

1764. Sensitivity of the Schering Bridge Network. E. Bradshaw. *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 144–146, *Jan.*, 1937.—In considering the sensitivity of the Schering bridge network when used for measurements of capacitance and dielectric loss angle at high voltages, certain simplifications of the analysis are made possible by the values of the branch components commonly met with in such measurements.
AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

1765. Generation of Heat in the Positive Column of Discharges in Monatomic Gases. K. Sommermeyer. *Ann. d. Physik*, 28. 3. *pp.* 240–244, *Feb.*, 1937.—The explanation of the voluminal increase of heat in the positive column in the discharge in the inert gases can only be (when some sources of error are considered) in the carrying over of impulse in the electron collisions to the neutral gas atoms. In a similar way calculation shows that the volume heat of the Hg high pressure discharge can only be explained by this impulse transmission to the neutral Hg atoms. J. J. S.

1766. Primary Ionisation in He and H_2. E. J. Williams. *Cambridge Phil. Soc., Proc.* 33. *pp.* 179–182, *Jan.*, 1937.—The observations of Cosyns that the primary ionisation produced in He by cosmic-ray electrons of energy $\sim 1000\ mc^2$ is about the same as that produced by β-particles of energy $\sim mc^2$ is shown to be adequately accounted for by theory when the departure of He from a H-like structure is considered. Closer consideration of available data suggests that theory and experiment on primary ionisation are in agreement in non-relativistic and strongly relativistic regions but not in the intermediate region where the energy is about $3\ mc^2$.
F. C. C.

1767. Angular Distribution in the Helium Double Excitation. S. B. Coles and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 257–261, *Jan.*, 1937.—The variation of probability of excitation of the doubly-excited state of He with change of energy of impacting electrons has been determined and compared with that of the $2 \times (2P)$ collision process. The maximum probability was found to occur in the region of 700 to 800 V. In both cases of the $(2s\ 2p)^1P$ and 3^1P losses the

V.4
193

variation of probability with angle has been determined for initial electron energies of 400, 800, and 1200 V. Comparison with theory shows qualitative agreement at 400 V. At 800 and 1200 V the 3^1P distribution shows a monotonic fall of intensity as the scattering angle increases, while the $(2s\,2p)^1P$ distribution exhibits a maximum at an angle of 4°–5°. No theoretical data are available for 800 and 1200 V. AUTHORS.

1768. Remeasurement of the Double Excitation Losses in Helium. W. Swift and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 262–264, *Jan.,* 1937.—A more reliable and more accurate determination of the double excitation in He $(1s)^2$–$(2s2p)$ leads to the value 59·73 V with a probable error of 0·01 V. This is somewhat higher than that previously reported by Priestley and Whiddington. The curious circumstance that the most probable excitation $(1s)^2$–$(3s2p)$ has not so far had its value theoretically determined is noted. AUTHORS.

1769. Molecular Excitation Potentials of Water Vapour. N. Thorley and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 265–269, *Jan.,* 1937.—Electron impact experiments in water vapour give excitation potentials of 7·60, 10·15, and 13·55 V, and a faint ionisation potential at 16·75 V. Estimates of the first ionisation potential from photometer traces gives a value of 12·35 V. These results are, in part, correlated with the u.v. absorption spectra of water-vapour and suggestions are made for the mode of excitation of the water-vapour molecule in terms of Mulliken's notation for the electronic structure of polyatomic molecules. AUTHORS.

1770. Ionisation and Dissociation of Polyatomic Molecules by Electron Impact. Part I. Methane. L. G. Smith. *Phys. Rev.* 51. *pp.* 263–275, *Feb.* 15, 1937.—The products of the bombardment of methane by slow electrons are analysed in a mass spectrograph. The following ions were found and their appearance potentials determined: Singly ionised CH_4, CH_3, CH_2, CH, C, H, H_2, H_3 and the negative ions of CH_2, CH, C and H. From the appearance potentials the heat of dissociation of CH_4 can be estimated and this leads to an upper limit for the sublimation energy of C, which must thus be less than 131 ± 16 k.cal. The connection between appearance potentials and ionisation potentials is discussed. R. P.

1771. Production of Multiply Charged Ions of High Energy. K. Schwarz and F. Ebster. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 6. *pp.* 425–447, 1936.—Tables are constructed that give the value of the potential to be applied across a discharge tube in order to produce multiply charged ions of high energy for elements up to K. The applicability of the tables is discussed according to the particular method used for producing the high potentials. F. C. C.

1772. Positive and Neutral Rays. Part V. A. Rostagni. *N. Cimento,* 13. *pp.* 391–406, *Nov.,* 1936.—An arrangement is described with transversal field for the study of the ionisation of gases by collision of ions and of atoms. A determination was made of the efficacious sections by the ionisation of the gases A, Ne, He, on the part of their own ions and of their own atoms respectively, at velocities comprised between 50 and 1100 V. The course of these goes on increasing with the velocity in the whole field, starting with a definite threshold for the separate cases. The relative thresholds for the ions and for the atoms practically coincide; the ratios of the respective efficacious sections differ little from unity. [For Part IV see Abstract 3138 (1935)]. J. J. S.

***1773. High Sensitivity Mass Spectrograph with an Automatic Recorder. P. T. Smith, W. W. Lozier, L. G. Smith and W. Bleakney.** *Rev. Sci. Instruments*, 8. *pp*. 51–55, *Feb*., 1937.—A mass spectrograph is described which is similar in principle to that used by Tate, Smith and Vaughan [see Abstract 4346 (1935)] but which is especially sensitive, registering rays of 10^{-6} times the intensity of the stronger rays present. An important feature of the apparatus is a motor driven continuously variable potentiometer synchronised with a moving photographic plate so arranged that the position of a light spot (registering the analysed ion current) reflected from a galvanometer mirror can be recorded as a function of the potential applied by the potentiometer to one of the electrodes in the apparatus. F. C. C.

1774. Chemical Reaction in Electric Discharges. Part II. Chemical Activity of Ions. R. W. Lunt. *Faraday Soc., Trans.* 32. *pp*. 1691–1700, *Dec*., 1936.—A discussion of various aspects of the hypothesis that the chemical reactions occurring in a gas discharge are attributable to ions leads to the following conclusions. (1) The analogies presented by reactions due to α-particles do not support the hypothesis since they themselves are probably due to the excitation caused by the α-particles. (2) The data for critical potentials for electron beams are below the ionisation potentials of the reactant molecules. (3) The arguments advanced from the general character of discharge reactions are shown to be inconclusive. (4) Collision processes in which energy of ion recombination may become available for initiating reactions are shown to belong to a class of infrequent events for the conditions obtaining in glow discharges. (5) There is only one example known for which there is direct evidence of chemical reactivity of an ion of low kinetic energy. Nevertheless, while there are many reasons for believing that chemical reaction in discharges is unlikely to be attributable to the ions present, any particular case must be considered on its merits. [For Part I see Abstract 5236 (1936)]. C. J. B. C.

1775. Chemical Reaction in the Electric Discharge. Part II. Synthesis of NO. E. J. B. Willey. *Roy. Soc., Proc.* 159*A*. *pp*. 247–262, *March* 15, 1937.—The product of the glow discharge in N_2-O_2 mixtures at about 7 mm. is shown to be NO, no other oxide being formed in any appreciable quantity. When mixtures rich in N_2 are used, some of the reaction product may be lost through reaction with active nitrogen, which is formed simultaneously but can be eliminated by appropriate introduction of a catalyst. Impulse discharges are much superior to a.c. and d.c. discharges both as regards absolute and power yields. The h.f. electrodeless discharge is also very efficient. It is suggested that reaction proceeds via the metastable $A^1\Sigma$ O_2 molecule, which is formed by collision of unexcited O_2 with energy-rich N_2 molecules derived from positive ions. This theory appears to explain very well both the present and many earlier observations upon the combination of N_2 and O_2 in the discharge, and is extended to show that it is neither necessary nor desirable to introduce ion clusters to interpret the course of such electrical reactions. [For Part I see Abstract 4657 (1935)]. AUTHOR.

1776. Electrical Methods of Counting. C. E. Wynn-Williams. *Phys. Soc., Reports*, 3. *pp*. 239–261, 1936.—Progress Review.

***1777. High-Speed Impulse Counter Circuit. J. H. E. Griffiths.** *Phys. Soc., Proc.* 49. *pp*. 85–88, *March* 1, 1937.—A simple circuit is described which gives one impulse to a recording meter for, say, 10 pulses from a Geiger-Müller counter or similar instrument. The limitations and conditions of operation are discussed, and it is shown that a correction of 10 % has to be applied at a counting speed of 3000 per min. AUTHOR.

*1778. **D.C. Production at High Voltage. A. Piekara and J. Kryczkowski.** *Phys. Zeits.* 38. *pp.* 67–68, *Jan.* 15, 1937.—Based on principles previously described [see Abstract 845 (1937)] a valve operating on 100–200 V d.c. produces potentials up to 10^4 V. These high potentials are suitable for Geiger counters as they are constant to about 1 %. F. C. C.

See also Abstracts 1423, 1518, 1643, 1708, 1783, 1812.

CONDUCTION IN SOLIDS AND LIQUIDS.

1779. Theory of Solids. Part I. F. Seitz and R. P. Johnson. *J. of Applied Physics*, 8. *pp.* 84–97, *Feb.*, 1937.—Summary of the electron theory of metals. R. P.

1780. Resistance of Monovalent Metals. E. L. Peterson and L. W. Nordheim. *Phys. Rev.* 51. *pp.* 355–364, *March* 1, 1937.—With the detailed knowledge available at present of the nature of the metallic state, an attempt is made to estimate quantitatively the resistivity of the monovalent metals. It is shown that the older conception of a " deformable " potential gives for Na a resistivity about 9 times too high. In our new formulation the resistivity is simply due to the fact that in a distorted crystal the proper solutions are not of the type of progressive waves, but linear combinations of these. The transition probabilities can be worked out under the assumptions that the charge distribution of the conduction electrons almost compensates the electrostatic potential due to the shift of the ions from their equilibrium positions and that in the undistorted crystal the periodic factor u_k in the wave functions $u_k \exp (2\pi i k\cdot \mathrm{R})$ does not depend sensibly on the wave number k. In this case only the average electronic density and not the exact form of the wave functions and potentials is found to be relevant. The result can be expressed by an interaction constant C, which measures the average scattering effectiveness of the elastic waves. The computation gives $C/E_0 = 0\cdot84$, where E_0 is the Fermi energy. The empirical values are for Na 0·77, K 0·81, Cu 1·12, Ag 1·21, Au 1·19. AUTHORS.

*1781. **Performance of Voltage Stabilisors in Continuous Operation. H. Gockel.** *Phys. Zeits.* 38. *pp.* 65–67, *Jan.* 15, 1937.—Several voltage regulators consisting of 2 stabilovolt tubes, type STV 280/40, in cascade are tested under conditions of continuous operation over long periods of time. The results show that the largest variations are those due to temperature changes, the coefficient being − 0·03 V in 70 V per °C. A regulator maintained at a constant temperature to within ± 0·1 °C gives a stability of ± 0·08 % for changes in the supply voltage not exceeding 10 %. At the beginning of operation the regulators change 0·7 % a day; after 30 days of operation, 0·01 % per day, and after 600 days they are practically constant. L. E.

*1782. **Electrical Instruments. L. H. Bainbridge-Bell.** *Journ. Sci. Instruments*, 14. *pp.* 57–61, *Feb.*, 1937.—A review of new electrical instruments shown at the Physical Society's Exhibition of 1937. L. H.

*1783. **Ionisation Current Meter. D. E. Lea.** *Journ. Sci. Instruments*, 14. *pp.* 89–94, *March*, 1937.—A thermionic amplifier is described enabling ionisation measurements to be made by the Townsend method, with automatic balancing. It is suitable for the measurement of ionisation currents of 10^{-10} to 10^{-14} A, and will also function as an integrating meter, reading in units of 0·1, 1·0, or 10 e.s.u. of charge. AUTHOR.

1784. Explanation of the "Branching" Temperature in Disc-Shaped Hot Conductors. E. Spenke. *Arch. f. Elektrot.* 31. *p.* 140, *Feb.* 18, 1937.—Corrections to the original article [see Abstract 336 (1937)].

1785. Supraconductivity and Theory of Metals. A. H. Wilson. *Phys. Soc., Reports,* 3. *pp.* 262–271, 1936.—Progress review.

1786. Nature of Electrons Concerned in Supraconduction. R. Forrer. *J. de Physique et le Radium,* 8. *pp.* 67–80, *Feb.,* 1937.—A theoretical treatment under the following heads. 1. Supraconduction and electronic lattice. 2. Discussion of the elements, supraconducting and non-supraconducting. 3. Discussion of the alloys, supraconducting and non-supraconducting. 4. Conclusions, predictions and mechanism. Supraconducting elements are divided into two classes, according to whether the m. pt. is low (Mg, Zn, Cd, Al, Ga, In, Sn, Pb), or high. Two rules are deduced : (*a*) In supraconduction, current is carried by *s*-electrons and in their absence supraconduction is impossible. This rule is verified by determination of the lattice of the supraconducting intermetallic compounds Hg_5Tl_2, Tl_2Pb, Bi_2Tl, Sb_2Tl_7, Au_2Bi ; (*b*) Alloys in which lattice electrons act as valency electrons, particularly those observing Hume-Rothery rules, cannot be supraconducting. The electron lattice of such alloys, $CuZn_3$, $AgZn_3$, Cu_3Sn, AuSn, PbSe, PbS, has been determined. To some extent the occurrence of supraconductivity can be predicted, SnTe and Cu_2Sb are discussed. The hypothesis is proposed that below a critical temperature *s*-electrons form a lattice of their own, superimposed on the atomic lattice, like that of ferromagnetics below the Curie point. The different order of magnitude of the two effects is assumed to be due to different contact mechanisms for *s* and for *p* electrons. D. R. H.

1787. Supraconducting Transition of Tantalum and of Tin. F. B. Silsbee, R. B. Scott and F. G. Brickwedde. *Bureau of Standards, J. of Research,* 18. *pp.* 295–314, *March,* 1937.—The transition from the supraconducting to the normal resisting state under certain conditions is found not to be continuous but to include a hitherto unsuspected spontaneous increase in resistance followed by a slower decrease. The spontaneous decrease in resistance usually proceeds for several minutes in a succession of steps until only a fraction of its crest value remains, which is sometimes 75 % of the normal After such an effect has occurred, it will not occur again when the same conditions are re-established, unless, in the meantime, the temperature has been lowered or else a time interval of at least half an hour has elapsed. These spontaneous changes in resistance can be initiated by a step upward in temperature, in current, or in magnetic field and proceed thereafter, as described above, while all three external conditions are maintained constant. The combination of temperature, field, and current at which this phenomenon appears is studied, and the progress of the resistance change under various conditions noted. The effect is pronounced only when the current is relatively large (about 2 A in the Sn wire, dia. 0·022 cm.). The transition temperatures of two specimens of hard-drawn Ta wire are found to be 3·961 and 4·068° K., respectively. The presence of a transverse magnetic field depressed the transition temperature at a rate of 1° K. per 1,250 oersteds. AUTHORS.

1788. Thermal and Electrical Conductivity of Bismuth Crystals in a Magnetic Field. E. Grüneisen and J. Gielessen. *Ann. d. Physik,* 28. 3. *pp.* 225–239, *Feb.,* 1937.—In two former papers [see Abstract

5716 (1936)] the change in the thermal and electrical conduction as well as the thermo-e.m.f. ϵ of Bi crystals in transversal magnetic fields was described. In the present paper the change in λ, K and ϵ on transition from transversal to longitudinal fields is given from the results of researches which in the last case were made with the magnetic field parallel to the longitudinal axis of the small crystalline rod conducting the current. J. J. S.

1789. Electrical Conductivity of Nickel-Sulphur Electrodeposits. H. Kersten and W. T. Young. *J. of Applied Physics*, 8. *pp.* 133–134, *Feb.*, 1937.—Under certain conditions, an electrodeposit from an aqueous electrolyte containing essentially nickel ammonium sulphate and sodium thiosulphate has an amorphous crystal structure and contains approximately 13 % S and 87 % Ni. It is shown that if this deposit is warmed to about 170° C. its electrical resistance suddenly decreases and its structure changes to crystalline, without appreciable change in weight. AUTHORS.

1790. Electrical Conductivity of Alkali Metal Films on Glass. A. C. B. Lovell. *Phys. Soc., Proc.* 49. *pp.* 89–94, *March* 1, 1937.—A description is given of an investigation of the electrical conductivity of the invisible thin films of the alkali metals which are deposited spontaneously on the walls of an enclosure in which they are sealed *in vacuo*. The resistivity of the films decreases in the order K, Rb, Cs. The resistivity of the Rb film is in reasonable agreement with a previous measurement given by Ives and Johnsrud [see Abstract 610 (1928)]. Some evidence is adduced in support of the view reached by the above workers that the thicknesses of these spontaneous deposits are of the order of those of monatomic layers. AUTHOR.

1791. Structure and Electrical Conductivity of Thin Films of Indium. V. E. Cosslett. *Phys. Soc., Proc.* 49. *pp.* 121–131; *Disc.*, 131–133, *March* 1, 1937.—The high electrical resistance and negative temperature coefficient that thin films of In, in common with other metals, exhibit when prepared under moderate vacuum conditions (10^{-4} to 10^{-5} mm.) and without exhaustive cleaning of the substrate, are shown by electron-diffraction methods to be in no way connected with the existence of any amorphous form of the metal. The lattice of freshly deposited films is found to correspond in form with that of the bulk metal but to have a spacing 0·7 % greater than that given by recent X-ray work, gold films here being taken as standards. With slowly deposited films the spacing increases and the axial ratio decreases with rise in temperature up to room conditions, and exposure to air carries this process further until a film showing a cubic In lattice with spacing 3·4 % greater than the bulk metal is obtained. This change is accompanied by slow oxidation, the oxide lattice being 0·6 % larger than X-ray values indicate. It is suggested that the high resistance of these films is due to sorption of residual gas, and that the negative temperature coefficient is the result of desorption and resorption processes; changes in crystal-size with temperature are also noted and discussed. The change in lattice constants is ascribed to the action of gas within the lattice, possibly amounting to the production of intermediate stages in oxide-formation. AUTHOR.

1792. Conductivity of Electrolytes in Alcohols. A. G. Ogston. *Faraday Soc., Trans.* 32. *pp.* 1679–1691, *Dec.*, 1936.—The electrical conductivities of solutions in methyl alcohol of KCl, $AgNO_3$, potassium methyl carbonate, tetra-ethyl-ammonium perchlorate, picrate, and bromide, potassium methoxide and HCl; in ethyl alcohol of KI, LiI, potassium ethyl carbonate, tetra-ethyl-ammonium perchlorate and picrate, potassium ethoxide and HCl are measured at 25°, 15° and 4° C. By the method of Fuoss and Krauss, the limiting conductivities and dissociation constants are obtained. The negative temperature coefficients of $\Lambda_0\eta$ and $l_0\eta$ in hydroxylic solvents are explained on the basis of the effect of electrostriction pressure on the local viscosity in the neighbourhood of ions. It is suggested that the methoxide and ethoxide ions exhibit abnormal mobility. Heats of dissociation are calculated and compared with values of the integral heats of dilution of electrolytes in methyl alcohol. AUTHOR.

1793. Conductivities of One-Molal Mixtures of Alkali Halides and Nitrates. P. van Rysselberghe and L. Nutting. *Am. Chem. Soc., J.* 59. *pp.* 333–336, *Feb.*, 1937.—The densities and the conductivities of nine pairs of alkali halides and nitrates are measured at a total concentration of one-molal. The mixture rule is found to be more nearly correct when the component salts have conductivities which differ but slightly. Attention is called to the wide discrepancies between measured and calculated conductivities in the case of solutions containing simultaneously the ions Na^+, K^+, Cl^- and NO_3^-. AUTHORS.

1794. Conductivities of Concentrated Binary Mixtures of Electrolytes. P. van Rysselberghe, S. W. Grinnell and J. M. Carlson. *Am. Chem. Soc., J.* 59. *pp.* 336–339, *Feb.*, 1937.—Specific and equivalent conductivities of eight groups of binary mixtures of 2–1, 2–2 and 1–1 electrolytes with a common anion are measured at total equivalent concentrations ranging from 0·5 to 9 N. It is pointed out that there is a marked parallelism between the difference of the conductivities of the pure salts and the maximum departure from the mixture rule observed with the mixtures of the same total concentration. AUTHORS.

1795. Conduction in Liquid Dielectrics. K. H. Reiss. *Ann. d. Physik,* 28. 4. *pp.* 325–352, *Feb.*, 1937.—The conductivity of liquid dielectrics such as hexane increases strongly when the field strength is increased above a certain critical value. A solution of hexane and anthracene is very similar in dielectric properties to hexane itself, and observations of the photoelectric currents in such a solution when subjected to radiation, yield information concerning the mechanism of conduction. The mobilities of the positive and negative carriers are 9·9 and 13×10^{-4} cm^2./sec. volt respectively. The increase of conductivity occurring at field strengths greater than 430 kV/cm. is attributed to ionisation by collision. In addition, the theories developed by Debye, Falkenhagen and Onsager to account for a similar increase of conductivity with field strength in electrolytes, are considered to be applicable to liquid dielectrics such as hexane. E. R.

See also Abstracts 1448, 1862, 1866.

DIELECTRICS AND CAPACITANCE.

1796. Dipole Moments of PF_5 and BF_3, and Vapour Pressure Curve of PF_5. R. Linke and W. Rohrmann. *Zeits. f. phys. Chem.* 35. *Abt.B.* 4. *pp.* 256–260, 1937.—Measurements of the dielectric constants of PF_5 and of BF_3 at temperatures between 282·8° and 472·3° Abs. indicate that neither fluoride possesses a dipole moment. The vapour pressure of liquid PF_5 between 180·6° and 188·6° Abs. can be represented by a relation of the form $\log p = -A/T + B$, p being measured in mm.

of Hg. A and B have the values, A = 898·9, B = 7·646. The sublimation vapour pressure curve between 147·5° and 179·4 °Abs. is likewise given by $\log p = -1518 \cdot 8/T + 11 \cdot 101$. The values of some of the physical constants of PF_5 deduced from these results are: heat of sublimation, 6940 cal./mol.; heat of vaporisation, 4110 cal./mol.; heat of fusion, 2830 cal./mol.; m.p., 179·4° Abs.; b.p. at 760 mm., 188·6° Abs.; Trouton constant, 21·79 cal./mol./deg. J. S. G. T.

1797. Structure of Xanthone and Orientation of Its *α*- and *β*-Dinitro-derivatives. C. G. le Fèvre and R. J. W. le Fèvre. *Chem. Soc., J. pp.* 196–202, *Feb.*, 1937.—The dipole moment of xanthone is found to be 3·11. The excess of this value over that calculated from diphenyl ether (*ca.* 1·0) and benzophenone (*ca.* 3·0) is largely due to electrostatic induction effects operating between different groups in the molecule. The amount of such induction is calculated. A fully dipolar form ($\mu = ca.\ 21$) cannot make more than a 3 % contribution to the real structure. The observed moments of two 2 : 7-disubstituted xanthones show that the links holding the substituents in each case are at 141–142° to each other, *i.e.*, that a nearly complete fixation of double and single bonds occurs in the xanthone skeleton. This result is in agreement with the theory of Mills and Nixon. On this basis the moments of the four possible dinitroxanthones have been calculated. "α-Dinitroxanthone" is thereby seen to be a slightly impure specimen of 2 : 4-dinitroxanthone. AUTHORS.

1798. Experimental Electricity and Magnetism: Dielectrics. L. Hartshorn. Alloys for Permanent Magnets. D. A. Oliver. Soft Magnetic Materials and Magnetic Measurements. C. E. Webb. Piezoelectricity. P. Vigoureux. *Phys. Soc., Reports,* 3. *pp.* 206–238, 1936.—Progress review.

See also Abstracts **1421**, **1782**, **1811**, **1862**.

ELECTROCHEMISTRY.

1799. End-Point Voltage of the Lead-Acid Storage Cell. K. Kinoshita. *Chem. Soc. Japan, Bull.* 12. *pp.* 25–31, *Jan.* 1937. *In English.*—The terminal voltage of the lead acid storage cell gradually falls in the course of discharge, and when the end-point voltage of the cell is reached the discharge must be terminated. Further discharge is said to result in the formation of crystalline lead sulphate in the active material of the plates, and thereby reduces the capacity and life of the electrodes. Experiments are made in which cells are discharged at different rates until the voltage is below that given by the makers of the cells, and to avoid the formation of crystalline lead sulphate by the experiments, the cells are recharged as soon as possible after discharge. The results show that a reasonable end-point voltage of the cell at a 6-hr. rate of discharge may be considered to be 1·784 V. F. J. B.

1800. Sulphate and Hydrogen Electrodes in Water-Free Hydrazine. H. Ulich and K. Biastoch. *Zeits. f. phys. Chem.* 178. *Abt.A.* 4. *pp.* 306–314, 1937.—The cell Zn | $ZnSO_4 - H_2SO_4$ in $N_2H_4 - CdSO_4$ | Cd, with Zn and Cd deposited electrolytically on Pt, did not give constant e.m.f.'s. After 2 hr. the cell (− ve) Zn duplex amalgam | $ZnSO_4$ | H_2SO_4 in N_2H_4 | $CdSO_4$ | duplex Cd amalgam (+ve) gave constant values of $E = 0 \cdot 3875$V at 20°C., $dE/d\theta = -0 \cdot 000472$ between 20° C. and 32° C. The cell + ve H_2 Pt electrode | H_2SO_4 in N_2H_4 | $ZnSO_4$ |

duplex Zn amalgam, gives true H_2 potentials. Since the values obtained satisfy the relation $\log f = -1\cdot283 \times 10^{-6} \times 2\sqrt{6c}/(\epsilon T)^{3/2} = -3\cdot11\sqrt{c}$ the dissociation is definitely that of $(N_2H_4)_2\,H_2SO_4$. The plot $\sqrt{c}$ against $\log f$ shows the best agreement with the theoretical curve when this is corrected for association with a sum of atomic radii of 2·5 to 3 Å inserted in Bjerrum's formula. Some deviation might be anticipated from the non-validity of Stokes' law in hydrazine. In crystalline sulphates the SO_4 tetrahedron is approximately equivalent to a sphere of radius 2·5 Å, in aqueous solutions the radius of the SO_4'' ion is found by Stokes' law to be 2·66 Å. On the assumption of a value of 2·6 for SO_4'' the ionic radius of N_2H_4 must be small, and solvation seems hardly possible. [See also Abstract 1348 (1937).] D. R. H.

1801. Kathodic Current Distribution in Galvanic Electrolytes. Part II. E. Mantzell. *Zeits. f. Elektrochem.* 43. *pp.* 174–186, *March*, 1937.—The earlier work is continued [see Abstract 3331 (1936)], and the method of investigation is applied to Ni plating baths. The technically important electrolytes for Ni plating are examined, and a classification of them on the basis of their throwing power is proposed. It is shown that the polarisation and the conductivity of the Ni baths are of extreme importance for the throwing power, and the maximum throwing power is best attained by the increase of the conductivity of the bath. The best method for increasing the conductivity is by the addition of suitable conducting salts. F. J. B.

1802. Adsorption Condenser and E.M.F. J. F. Chittum and H. Hunt. *J. Phys. Chem.* 40. *pp.* 1083–1093, *Dec.*, 1936.—An explanation of overvoltage and electrokinetic potentials is offered. The origin of e.m.f. is described as well as the mechanism for conduction processes at a metal–solution interface. The explanation is based upon a colloidal layer of metal on the crystalline metal surface. AUTHORS.

1803. Kelvin Single Potential Differences. W. D. Bancroft and J. D. Porter. *J. Phys. Chem.* 40. *pp.* 1201–1216, *Dec.*, 1936.—The source of the e.m.f. of a voltaic cell is discussed and the alternative theory to that which ascribes the p.d. of a voltaic cell to the heat of reaction is considered. It is pointed out that the heat equivalent of any metal-metal potential appears in the heat of reaction as usually measured. Experiments were made in which the potentials of different metals were measured with an ionised air gap at each junction in a voltaic cell, so that it was possible to measure the Kelvin single p.d. The work was continued and applied to the case of two-phase binary alloys, and it was found that the Kelvin single p.d. was a function of the nature and relative masses of the two phases. In the case of the Daniell cell it was shown that practically all the e.m.f. arose from the Cu-Zn junction, the p.d.s at other junctions being approximately zero. It was not found possible to obtain information about passive iron with an ionised air gap. F. J. B.

1804. Potentials of Hydrogen and Glass Electrodes in Concentrated Acid Solutions. J. A. Cranston and H. F. Brown. *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 32–45, *Jan.*, 1937.—The potentials developed by the H_2 electrode in aqueous solutions of formic, acetic, propionic, ortho-phosphoric, and sulphuric acids are measured over a wide range in concentration, and the magnitude of the junction potential with saturated KCl is calculated for one of them. The behaviour of the glass electrode in these solutions is recorded. AUTHORS.

1805. Iodine-Iodate Electrode. W. O. Lundberg, C. S. Vestling and J. E. Ahlberg. *Am. Chem. Soc., J.* 59. *pp.* 264–268, *Feb.*, 1937.—The electrode potentials of the iodine-iodate electrode reaction are measured at several concentrations and its standard electrode potential evaluated. The free energy, entropy and heat of formation of iodate ion are also evaluated.

***1806. Glass Electrode for pH Control. K. Schwabe.** *Zeits. f. Elektrochem.* 43. *pp.* 152–155, *March*, 1937.—A spherical glass membrane is filled with a solution having the desired pH-value and is placed in the solution to be controlled. Differences in pH on the two sides of the glass cause p.ds. which affect an instrument connected between electrodes of like type placed in the respective solutions. Arrangements are described whereby, with the aid of delicate relays or a mirror galvanometer and photo-cells, the variations of e.m.f. operate valves which release acid or alkali for the automatic regulation of the pH-value. Applications of the glass electrode for the indication of the end-points of titrations are also described. L. A. W.

1807. Electric Potentials at Silver Halide Surfaces. I. M. Kolthoff and H. L. Sanders. *Am. Chem. Soc., J.* 59. *pp.* 416–420, *Feb.*, 1937.—An expression has been derived for the e.m.f. E of cells involving silver halide membranes. It was found that $E = E^0 + RT/F\, ln(a_2)$. The experimental results obtained with fused silver halide membranes over a wide range of values of a_2 showed that $E = E^0 + A\, ln(a_2)$ in which A was found to be slightly less than the theoretical value.

1808. Potentials of Copper in Solutions of Cupric Benzenesulphonate. Marguerite Quintin. *Comptes Rendus*, 204. *pp.* 422–424, *Feb.* 8, 1937.—Deduced from the potentials (E) of the cell $-$Cu (amalgam two phases) | $Cu(PhSO_3)_2$, *c* | KCl, satd. | KCl, 0·1*M* | Hg_2Cl_2, Hg +, which are, for *c* (concentration of $Cu(PhSO_3)_2$) 0·1, 0·01 and 0·001—*M*, 0·0352, 0·0598 and 0·0844 V respectively, those of Cu (E_{Cu}) in solutions of $Cu(PhSO_3)_2$ of the same concentrations are $-$ 0·3024, $-$ 0·2778, and $-$ 0·2532 respectively, and E_0' ($= E_{Cu} + [RT/2F]\log c$) are $-$ 0·3320, $-$ 0·3369 and $-$ 0·3419 V; whence E_0 (the "normal" potential, *i.e.*, when $cf = 1$, *f* being the activity coefficient) $= -$ 0·3454 V. These results imply that Debye's theory applies to solutions of $Cu(PhSO_3)_2$, at least when of small concentration. Similar data are also given for four intermediate concentrations. C. A. S.

1809. Electrolytic Valve Action in Liquid Ammonia as Solvent. A. Günterschultze and H. Betz. *Zeits. f. Physik*, 104. 5–6. *pp.* 440–441, 1937.—Unsuccessful attempts are made to study electrolytic valve action in liquid NH_3. It is found impossible to "form" Ta in any electrolyte in this solvent. After "forming" in aqueous solution, the reproducibility of the current-voltage curves in liquid NH_3 is unsatisfactory. Incomplete "forming" is attained for Al in liquid NH_3 containing boric acid or borate, but the oxide layer flakes off. No sign of "forming" is observed with Mg, Cu or Fe. L. A. W.

***1810. Cell for E.M.F. Measurement of HCl in Dioxane-Water Mixtures. H. S. Harned and J. O. Morrison.** *Am. J. Sci.* 33. *pp.* 161–173, *March*, 1937.—A galvanic cell containing H_2 and a Ag–AgCl electrode is described by means of which the thermodynamic properties of HCl in dioxane-water mixtures may be determined. By using all glass vessels, and by completely excluding air, e.m.f.s reproducible to within

± 0·03 mV have been obtained in mixtures possessing a dielectric constant of the order 10 to 20. These results are about ten times the accuracy of any of similar nature previously obtained in such media. Both the cell and technique may be recommended for use in other non-aqueous solvents, or non-aqueous solvent-water mixtures. AUTHORS.

1811. Electrostriction of Strong Electrolytes. E. Ernst and J. Truka. *Phys. Zeits.* 38. *pp.* 103–104, *Feb.* 1, 1937.—On solution the volume occupied by 1 gm.mol. of a strong electrolyte apparently decreases by a quantity v. Extrapolation of the v-values gives a value v_∞ for infinite dilution. In a short note the authors point out that, just as "degrees of dissociation" Λ/Λ_∞ can be calculated from conductivities, so also can analogous values be given for v/v_∞. These are nearer to unity than the corresponding values of Λ/Λ_∞, but still cannot be regarded as true measures of the degrees of dissociation. L. A. W.

See also **Abstracts 1471, 1472, 1485, 1732.**

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

***1812. Production of Positive and Negative Electron Pairs in a Cloud Chamber. L. Simons and K. Zuber.** *Roy. Soc., Proc.* 159*A*. *pp.* 383–394, *April* 1, 1937.—Positron and electron pairs produced in A and in methyl iodide vapour in a Wilson chamber by the γ-rays from Th C″Pb are photographed. The energies of the partners are measured, and it is found that the majority of the pairs are probably due to γ-rays of $2\cdot62 \times 10^6$ eV. Some evidence is also found for the existence of a γ-ray quantum of high energy lying between 3·0 and $3\cdot6 \times 10^6$ eV. The distribution with number of the energy of the particles is investigated and it is found that in A, the average energy of the positrons is approximately equal to that of the electrons, but that, in methyl iodide there is a difference between their average energies of the same order as that given by the theory of Jaeger and Hulme. The distribution in direction of ejection, relative to the incident γ-rays, agrees with the theory of Bethe and Heitler. It is found that the average angle between the positron and electron is about 30°, for both A and I. A new instrument is devised especially useful for measuring the curvatures of tracks in gases of high atomic number in which there is always some scattering. AUTHORS.

1813. Classical Dynamics of the Electron. First Integrals and the Intrinsic Moment of the Electron. B. Kwal. *Comptes Rendus,* 204. *pp.* 560–562, *Feb.* 22, 1937.

1814. Recent Values of the Constants *e* and *h*. R. Ladenburg. *Ann. d. Physik,* 28. 5. *pp.* 458–464, *March,* 1937.—Improved measurements of the wave-lengths of X-rays and a new evaluation of the oil drop determinations of e, using an improved value of the viscosity of air, lead consistently to the value 4·803 ± 0·002 for e. Using this for the evaluation of h from Rydberg's constant the value of $h = 6\cdot627$, while five precision measurements of the limit of the continuous X-ray spectrum lead consistently to the value $h = 6\cdot609$. The discrepancy between the two values for h is apparently outside the experimental error of both methods and is as yet unexplained. R. P.

1815. Electron Diffraction by Polymerised Aliphatics. G. Natta and R. Rigamonti. *Accad. Lincei, Atti,* **24.** *pp.* 381–388, *Nov.* 15, 1936.—The reflection of electrons of 40–60 kV energy from layers of polymerised aliphatics 10^{-5} cm. thick gave in some cases interference bands as for liquids and in other cases sharp interferences lines as for bodies possessing crystalline structure. Some of the compounds examined were intermediate in their behaviour. F. C. C.

1816. Motions of Electrons in Magnetic Fields and Alternating Electric Fields. L. G. H. Huxley. *Phil. Mag.* **23.** *pp.* 442–464, *March,* 1937.—In many theoretical treatments of the motions of electrons in gases in electric fields by the method of free paths, no account is taken of the effect of the electric field on the time spent between collisions of electrons with gas molecules. In a previous paper an investigation is given of the motion of electrons in a gas under a steady electric field accompanied by a magnetic field, in which allowance was made for the effect of the field on the " free time " between collisions [see Abstract 1357 (1937)]. In the present paper the same methods are used to investigate the motion of electrons in gases, under the action of simple harmonic electric fields either with or without an accompanying constant magnetic field. A general formula is obtained which contains several previous formulæ as special instances. The investigation is of interest for the study of the ionosphere by means of radio waves. AUTHOR.

1817. Equations of Motion of Electrons in Gases. J. S. Townsend. *Phil. Mag.* **23.** *pp.* 481–486, *March,* 1937.—In investigations of the motion of ions and electrons in gases under the action of an electric field, it is usually assumed that the equations of motion are of the same form as those in Maxwell's theory of interdiffusion of gases. These equations of motion require that there shall be a simple relation between the coefficient of diffusion and the mean velocity due to the electric force. It was shown in a previous paper [see Abstract 3854 (1936)] that these equations are consistent with the expressions for the coefficient and the velocity of the electrons when the distribution of the energies of the electrons satisfies a certain condition. The Maxwellian distribution is of this form, but in general the velocities of agitation are not distributed as widely as in Maxwell's distribution. It is shown that the mean velocities are not given accurately by these equations of motion, the error being large when the charged particles have a mass which is small compared with that of a molecule of the gas, and a more general equation is derived. C. J. B. C.

***1818. Electron Mirror. A. Recknagel.** *Zeits. f. Physik,* **104.** 5–6. *pp.* 381–394, 1937.—A definition is given of an electron mirror and its mode of operation is briefly described. A detailed mathematical treatment is then given in terms of the usual electron-optical expressions and certain imagery defects are pointed out. A method is described for determining the paths of electrons in any electron mirror system and a special type of mirror is described which may be used as an *Einzellinse.* [See also Abstract 897 (1937).] H. J. H. S.

1819. Ray Paths in Electron Optics. R. Gans. *Zeits. f. techn. Physik,* **18.** 2. *pp.* 41–48, 1937.—The potential fields along the axis of a diaphragm and of an immersion lens are calculated and certain numerical factors are given in tabular form from which the ray path and the position of the focal and principal planes may be calculated. A method is given for integrating the path equations and is illustrated by numerical examples on the immersion and diaphragm lenses. Two additional methods are described for calculating the ray paths, one termed the polygon method and the other the parabola method (this is an approximation method) and examples of their use are given. H. J. H. S.

1820. Convergence of Electrons by Magnetic Coils. A. Bouwers. *Physica*, 4. *pp*. 200–206, *March*, 1937. *In English*.—The focusing effect of magnetic coils with respect to electron beams is investigated. The lens effect of a short coil is explained in an elementary manner and the path followed by the electrons described. Formulæ are derived for the focal distance and for the angle of rotation round the axis for short and long coils. Special cases are discussed, as the border case between short and long coil and the effect of the nonhomogeneous strong field. AUTHOR.

1821. The Electron: Its Intellectual and Social Significance. K. T. Compton. *Science*, 85. *pp*. 27–37, *Jan*. 8, 1937. *Nature*, 139. *pp*. 229–240, *Feb*. 6, 1937. *Supplement*.—An historical account is given of the experimental investigations leading up to the discovery of the electron and of the subsequent developments both on the theoretical and the industrial sides. G. C. McV.

See also Abstracts **1411, 1422, 1452, 1457, 1458, 1459, 1557, 1615, 1632, 1765, 1863, 1864.**

ELECTROSTATICS.

See Abstract 1718.

MAGNETISM AND ELECTROMAGNETISM.

1822. Magnetism. L. F. Bates. *Phys. Soc., Reports*, 3. *pp*. 175–205, 1936.—Progress review.

1823. Curie Point. A. Kussmann and A. Schulze. *Phys. Zeits*. 38. *pp*. 42–47, *Jan*. 15, 1937. *From the Reichsanstalt*.—In recent years writers have derived the magnetic Curie point from the temperature at which the temperature-coefficient of electrical resistance is a maximum. It is shown by numerous magnetisation-temperature curves taken in very weak fields for Ni and Ni alloyed with Cu, Cr, Si, W, Al, Co and Fe, and comparison with resistance-temperature curves for the same specimens that this does not hold. The difference between the two temperatures varies from zero to 45° C. The Curie temperature in the ideal case of absolute homogeneity gives a sharply defined point and not a "Curie range." G. E. A.

1824. Law of Magnetisation of Ferromagnetics in Weak Fields. M. Kersten. *Zeits. f. techn. Physik*, 18. 2. *pp*. 39–41, 1937.—A summary is given of the essentials of the work of Rayleigh on the behaviour of ferromagnetics in weak fields and of the extension of his work by H. Jordan. Their results are shown to be of the greatest importance in telephonics. H. J. H. S.

1825. Magnetic Behaviour of Alums of the Iron Group. A. Siegert. *Physica*, 4. *pp*. 138–152, *Feb*., 1937. *In German*.—The general theory is extended to the case in which the magnetic ion lies in a very strong cubical crystal field. For Cr_{+++}, Mn_{+++} and Fe_{+++} the quenching is completed in the cubical field, whereas with Ti_{+++} and V_{+++} it is only attained with an additional trigonal field. The crystal structure lends support to a probable strong field of cubical symmetry and a weaker field of trigonal symmetry. The case of vanadium (2 electrons) is calculated, and the hypotheses are stated on which calculations are made of the relation of temperature to susceptibility and the first appearances of saturation. [See also Abstract 1867 (1936).] G. E. A.

1826. Exchange Interaction in Magnetic Crystals. W. Opechowski. *Physica,* 4. *pp.* 181–199, *March,* 1937. *In English.*—A simple method, due to Kramers, of approximate evaluation of the partition function (*Zustandssumme*) in the case when $kT > |J|$ (J = the exchange integral), but $\mu H/kT$ arbitrary, is explained and applied to discuss some questions related to ferromagnetism ($J > 0$) and to the adiabatic demagnetisation experiments at low temperatures ($J < 0$).
AUTHOR.

1827. Magnetic Susceptibilities of the Ammonium Halides. A. Dinsdale and F. A. Long. *Leeds Philosoph. and Lit Soc., Proc.* 3. *pp.* 270–276, *Jan.,* 1937.—Measurements on the magnetic susceptibility of ammonium chloride, bromide, and iodide have been made from −180°C. to above the temperatures at which they transform from CsCl structure to that of NaCl, at which point, the change in environment of the ions may be expected to result in an increase in susceptibility. From room-temperature measurements and other data estimates are made of the change to be expected. Curves showing the variation below 0° C. show unexpected increases at low temperatures, but not the expected change at the transition points of NH_4I. The measurements on NH_4Cl and NH_4Br indicate a small increase in susceptibility in passing from the CsCl to the NaCl structure, but further comfirmatory measurements are desirable.
AUTHORS.

1828. Diamagnetic Susceptibility of Thallium Compounds. Violet C. G. Trew. *Faraday Soc., Trans.* 32. *pp.* 1658–1667, *Dec.,* 1936.—The mass susceptibilities of 27 thallous compounds give a mean value of $-38 \cdot 4 \times 10^{-6}$ for the thallous ion in salts with univalent anions. Salts with divalent and tervalent anions give a slightly lower value, and salts with organic anions a higher value. A comparison of the atomic susceptibility, as calculated from Slater's approximate wave functions, with the experimental value, which is considerably lower, indicates a discrepancy between theory and experiment. The ionic radius, deduced from the atomic susceptibility, is 1·36 Å. Certain facts indicate that Slater's method gives too high a value for the screening constants of the $5d$ and $6s$ levels.
G. E. A.

1829. Resonance in Urea and Its Derivatives. Part I. Diamagnetics. A. Clow. *Faraday Soc., Trans.* 33. *pp.* 381–388, *March,* 1937.—The possible resonance structures of urea and 18 of its derivatives has been investigated by a discussion of their diamagnetic susceptibilities, following the method of Gray and Cruickshank [see Abstract 5232 (1935)] which reveals a change in the parent molecule from a resonating zwitterion in urea itself through an amino-imino structure in N-mono-substituted ureas to carbamide in a tetra-substituted molecule. When there is a $C::N$ group in the molecule this is shown to resonate between $\overset{\cdot\cdot}{C}::N:$ and $\overset{+}{C}:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{N}}:$.
AUTHOR.

1830. Magnetic Anisotropy and Electronic Structure of Aromatic Molecules. Kathleen Lonsdale. *Roy. Soc., Proc.* 159*A*. *pp.* 149–161, *March* 2, 1937.—The remarkable anisotropy of benzene, cyanuric and phthalocyanine compounds may be explained on the assumption that, whereas the normal valency electrons behave as if they were spherically symmetrical and free to precess under the influence of any magnetic field, the π electrons occupy plane orbits which are free to process only in their own plane. The radius of the *s*-electron orbits calculated from susceptibility data is about 0·7 Å, that of the plane orbits occupied by the benzene π electrons is 1·55 Å, which agrees well with the theory of molecular orbitals. The anisotropy of cyanuric compounds is only about one-half the value expected for complete conjugation, but in phthalocyanine the 14 π electrons in the central closed ring appear to occupy molecular orbitals of area a little larger than that of the central ring itself. [See also Abstract 5300 (1936).] AUTHOR.

1831. Influence of Elastic Tension on Magnetostriction. B. K. Girenchin. *Phys. Zeits. d. Sowjetunion*, 10. 5. *pp.* 689–693, 1936. *In English.*—The rotating mirror method used by Honda is employed to investigate the effect of tension on the magnetostriction of Ni wires (annealed in H_2 at 900° C.), 30 cm. long and 0·09 cm. in dia. Fields up to 800 Oe. and tensions varying from zero to 1·66 kg./mm². are used. The magnetostriction, λ, is plotted against $(J/J_\infty)^2$ as well as the magnetisation J(H) for various values of tension. In agreement with the theories of Akulov and Kondorsky, the curves $\lambda = f(J^2/J_\infty^2)$ are straight as far as $(J/J_\infty)^2 \approx 0{\cdot}55$, but at that point the slope changes and continues linearly up to saturation. H. J. H. S.

1832. Magnetostriction in Degenerate Electron Gas. D. V. Gogate. *Phil. Mag.* 23. *pp.* 487–490, *March*, 1937.—Pauli's expression for paramagnetic susceptibility is derived from Boltzmann's formula for the degenerate case. The increase of pressure of the degenerate electron gas is calculated from the increase of null-point energy effected by application of a magnetic field, which causes some of the electrons to migrate to previously unoccupied higher energy levels or phase cells. The slight increase of volume of the degenerate gas, which must occur if the pressure is to be kept constant, is calculated, and leads at once to a formula for the magnetostriction. J. S. G. T.

***1833. Excitation Windings of Large Electromagnets. A. Cotton.** *R.G.E.* 41. *pp.* 131–138, *Jan.* 30, 1937.—Continuing the comparisons between the large electromagnet of the University of Upsala and that of the Académie des Sciences at Bellevue [see Abstract 922 (1937)], the author examines the characteristics of the field windings of the two magnets. The windings of the Bellevue instrument are of slightly higher efficiency, and the stronger direct field of the Upsala magnet is due to the use of much higher current densities. The coefficient of enlargement of the coils in the Upsala magnet is nearly half that of the Bellevue coils; this is favourable to efficiency and compensates for the less advantageous form of the windings, but it reduces the space available for cooling-water and insulation. The author justifies the form of yoke chosen for the Bellevue magnet, and shows that the use of supplementary coils enables the strength of field in the gap to be increased to 20,000 gauss. In conclusion, the author refers to a number of investigations which could not have been made without the Bellevue magnet. R. E. N.

See also Abstracts 1541, 1544, 1785, 1798.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***1834. Apparatus for Investigating Nerve-Action and Similar Currents. W. Schmitz.** *Zeits. f. techn. Physik*, 18. 2. *pp.* 37–38, 1937.—By means of a rectifier arrangement operating on a self-induction, an alternating current of normal frequency is made to give a pulse-series of short duration. With this series it is possible to activate nerves and other physiological processes, and project the resulting currents on to a fluorescent screen of an oscillograph. Further applications are found in acoustic research. G. E. B.

***1835. Electrical Stimulating Device for Use with Sensitive Recording Systems. R. J. Pumphrey and A. F. Rawdon-Smith.** *Journ. Sci. Instruments*, 14. *pp.* 100–102, *March*, 1937.—A device is described whereby the "stimulus escape" associated with the use of electrical excitation when recording from nerve may be greatly reduced. The equipment consists essentially of a double-wound transformer for coupling the stimulating source to the preparation, and is so arranged that the electrode winding is completely screened electrostatically from the primary, or excited winding. AUTHORS.

1836. Biological Action of Short Waves. J. Latkowski and (Miss) B. Charlampowicz. *Acad. Polonaise Sci. et Lettres, Bull. BII. No.* 3–4. *pp.* 189–204, *March–April*, 1936. *In German.*—In spite of a large literature regarding medical applications of short Hertzian waves there is no extensive information in respect to the action of these waves upon the blood. A review of previous investigations is given and methods employed by the present authors to investigate changes in the blood of rabbits after irradiation. Methods to determine the Ca content, the Cl content, H-ion concentration, sedimentation rate, albumen and globuline are briefly mentioned and the results of changes on irradiation are given in tabular form. It is found that Hertzian waves, whilst having a much longer wave-length than u.v. and X-rays, give rise to similar blood changes, probably owing to a common effect, due to increase of temperature in the tissues. The cellular colloids are very sensitive to radiation and the various changes in the blood in respect to viscosity, H-ion concentration and sedimentation rate are all related to the conditions of electrical charge. B. J. L.

1837. H.F. Conductivity and Dielectric Constant of Biological Tissues and Fluids. K. Osswald. *Hochfrequenztechn. u. Elektroakustik*, 49. *pp.* 40–49, *Feb.*, 1937.—The barretter method of Wien was employed to measure, in the short-wave region employed largely in electrotherapy (3 to 12 m.), the conductivity and dielectric constant of biological tissues and fluids, comparison being made with the results of l.f. measurements. The measured l.f. conductivities of muscle substances were found to differ little from the results obtained by other investigators. In the case of all tissues a marked feature is the high ratio of the h.f. to the l.f. conductivity. This ratio is in some instances as high as 10 : 1. For a few substances (brain, liver and spleen) a definite dependence of the h.f. conductivity on frequency was observed. The dielectric constants of the substances dealt with increase rapidly with wave-length and also increase with temperature. For $\lambda = 12$ m. values were found exceeding 200. The results show that Dänzer's application to blood of Wagner's theory of layered media can also be extended to tissues in general. The significance of the results in short-wave therapy is discussed and the possibility is advanced of producing selective heating of individual tissues by suitable choice of the wave-length. The possible use of waves shorter than 2 m. is also discussed. A. W.

1838. Light and Dark Fringes Bordering the Degraded Edges in Radiographs (Mach Effect). B. Demetrović. *Ann. de Physique*, 7. *pp.* 141–229, *Feb.*, 1937.—The light and dark fringes which can be observed on radiographs are studied. These fringes appear with different visibility and size on each side of the penumbra; on the dark side the fringe is light, and on the other side it is black. The characteristics of these fringes depend on the size of the penumbra, the thickness of the screen and the structure of the source. If the screens are very transparent the black fringe only appears. The causes of the fringes and the variation in their appearance are probably due in part to objective effects, *e.g.*, diffraction, refraction, total reflection, and in part to the physiological effect discovered by Mach. The effect of each of these factors on a Mach fringe is studied, and it is concluded that the major influence is that due to the Mach effect. Nevertheless, the aspect of fringes bordering the penumbra is strongly influenced by objective effects due to the nature of the source and probably to refraction. C. J. B. C.

1839. Dangers of Reducing Fractures under the Roentgenoscope and Methods of Protection against Them. C. A. Stevenson and E. T. Leddy. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 70–82, *Jan.*, 1937.—A present-day common surgical procedure is to reduce fractures under the control of the X-ray screen, with obvious advantages. This procedure is very dangerous to the operators if repeatedly performed as in an accident ward. The present paper deals with measurements to ascertain the dosage received by the hands of the operators. At 80 kV and 6 mA tube current the operators' fingers receive an erythema dose in the short space of 7 min. and 45 sec. Filtration of the rays extends this time to 24 min. with a 2 mm. Al filter. The erythema time increases as the fingers are withdrawn from the centre of the field of radiation. The material of which the surgical table top is made has a definite protective value, although the actual material does not essentially modify the dosage. In the literature there are no specific warnings or recommendations in regard to this type of X-ray work. The authors conclude that the procedure is very dangerous and that the operator may receive severe injury in a single reduction of a fracture, as well as by cumulation of dosage by repeated performance. Such reduction is condemned unless the operator carefully measures the dosage he will receive. The possibility of mechanical manipulation of fractures is discussed. B. J. L.

1840. Paraffin and Water Phantoms. E. H. Quimby and A. N. Arneson. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 93–97, *Jan.*, 1937.—To estimate the intensity of radiation at a depth in the patient's body, a water phantom is commonly used, the depth of water being considered as equivalent to the depth of body tissue, the intensity of radiation is measured at the given depth of water. To avoid the inconvenience of a fluid, water has been replaced by paraffin wax, this having, however, a density of 0·9 instead of 1·0. Comparative data are given of measurements made with water and wax. The findings show that a paraffin phantom should not be used to determine depth doses to be applied in therapy, as measurements are not directly applicable and cannot be readily corrected. Beeswax of density 0·97, whilst more expensive, tends to be more accurate and Parker, with a unit density wax, has obtained results in agreement with the water phantom. For physical and biological investigation wax phantoms can be used for convenience, but the more accurate water phantom is preferable. B. J. L.

1841. Intensity and Quality of X-Ray Output. C. J. Zintheo, Jr. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 98–104, *Jan.*, 1937.—Ionisation measurements are detailed as to the intensity of radiation in the plane of the central ray of a line focus X-ray tube, normal to the anode face and at various angles to the central ray. There is marked difference of intensity of unfiltered radiation at different angles and the maximum intensity was found about 10° from the central ray towards the kathode. Filtration *via* 5 mm. of Al showed smaller variation but the variation of intensity varies with the quality of radiation. Comparisons of non-protective and auto-protective line focus tubes showed variations both in respect to quality and quantity of radiation, which also varied when change of rectifying valves was made. B. J. L.

1842. Photographic Method of Comparing the Intensities of X-Rays. H. L. Brose and E. H. Molesworth. *Brit. J. of Radiology,* 10. *pp.* 55–59, *Jan.,* 1937.—Describes an adaptation of Ornstein's method in the sensitometry of photographic films to the study of films blackened by X-rays in order to determine the relative intensities of beams of radiation. In this method the blackening of the film is measured in arbitrary units by comparison with films blackened by the same radiation after filtration by filters of known absorbing power, transmitting 50 % and 25 % of the incident radiation. Passing a suitable beam of light through the standard films and noting the transmission by, say, a photronic cell, enables a curve to be plotted relating the intensities of the sources to the deflection of the measuring instrument associated with the cell, and from this the relative intensities of the various beams may be read from their photographic effects. G. E. B.

***1843. Lost and Found Radium. R. B. Taft.** *Am. J. of Roentgenology and Radium Therapy,* 37. *pp.* 87–92, *Jan.,* 1937.—In the clinical application of radium, from time to time this valuable material is lost by being thrown away with dressings, etc., instances being given. Prevention of loss by means of retention of dressings for a certain time to permit discovery of the loss and tracing are discussed, together with a suitable electroscope detector which has been used when radium has been thrown with refuse at a dust shoot. B. J. L.

1844. Dosage System for Radium Therapy. B. E. Wright. *Am. J. of Roentgenology and Radium Therapy,* 37. *pp.* 83–86, *Jan.,* 1937.—A mathematical and graphical paper dealing with the dosage received from a point source of radon, expressed in mg.-hr./cm^2., a formula being given which can be integrated for the average intensity over a surface from a point source, or at a point from a non-point source. B. J. L.

***1845. Pneumatic Transference of Radium in a Beam Unit. L. G. Grimmett.** *Brit. J. of Radiology,* 10. *pp.* 105–117, *Feb.,* 1937.—A description is given of the new 5 gm. Ra unit at the Radium Beam Therapy Research. The Ra is contained in 25 monel metal tubes which are inserted in a steel bobbin 3·5 cm. dia. In the process of pneumatic transference, this bobbin is blown by air pressure, from the safe, along a flexible metal pipe which is lagged with marline and covered with leather or cotton braiding, to the beam unit. The air pressure is supplied by a commercial vacuum cleaner while a two-way tap controls the direction of flow. An electrical stop-clock, arranged to run only when the Ra is in the unit, integrates the total exposure. Other new features of the apparatus include the use of heavy W alloy for protection purposes, a variable Pb screen on the underside of the unit and a directional caliper for accurate location of the beam. [See Abstract 1383 (1937).] T. A. C.

1846. Intensity Distribution in Water of Radium Radiation. E. E. Wright. *Brit. J. of Radiology,* 10. *pp.* 118–122, *Feb.,* 1937.—The intensity distribution in a water phantom of the γ-radiation from a 5 gm. Ra unit has been measured by Sievert's condenser chamber method using ionisation chambers of elektron metal. Measurements were made with two fields 5 cm. and 8 cm. dia., the Ra-skin distance being 8·3 cm. The Ra was contained in 25 monel metal containers and these inserted in a steel bobbin 3·5 cm. dia. Contours showing the intensity values in *r* per hour are given. Assuming 9·4 *r*/hr. per mg. at 1 cm. for 0·5 mm. Pt filtration as the conversion factor, the percentage depth doses at 10 cm. depth, based on the extrapolated surface dosage rate of 630 *r*/hr., were found to be 14·7 % for the small field and 16·5 % for the large field. T. A. C.

***1847. γ-Ray Measurement of Radium Content by Ballistic Valve Amplifier. G. W. C. Kaye, W. E. T. Perry and D. E. A. Jones.** *Brit. J. of Radiology*, 10. *pp.* 282–290, *March*, 1937.—The paper gives the details of a single-stage d.c. amplifier which, together with a large cylindrical ionisation chamber, serves as a precision instrument for radium measurements by the γ-ray method. A high degree of stability is attained by an arrangement which incorporates a condenser in the output circuit of the valve. The amplifier, which serves either as a null or a ballistic deflection instrument, is considerably quicker in operation, and is normally capable of yielding results which are as accurate as those obtained with the standard ionisation chamber and gold-leaf electroscope employed for routine radium measurements at the National Physical Laboratory. AUTHORS.

1848. Clinical Acoustics. A. Pierach. *Naturwiss.* 25. *pp.* 67–70, *Jan.* 29, 1937.—Diagnosis of many medical and surgical conditions depends, as in the thorax, upon variations of sounds arising from passage of air *via* the lungs (auscultation) or the conduction of sound given out when organs are struck (percussion). These sounds may be recorded by use of a condenser-microphone, amplifier and oscillograph. Examples of the oscillograph readings so obtained are given, and changes which occur in lung tissues may be investigated, in analogy, by a rubber sponge model. By such means clinical auscultation and percussion can be extended in their usefulness and the exact origin of abnormal sounds, previously a matter of opinion, can be definitely settled. B. J. L.

See also Abstract 1572.

OSCILLATIONS AND WAVES.

1849. Surplus Heating of a Kathode in a Magnetron. I. M. Wigdortschik. *Phys. Zeits. d. Sowjetunion*, 10. 5. *pp.* 634–648, 1936. *In English.*—The surplus heating of a kathode filament of a one-plate magnetron is studied. Presuming that the distribution of electronic velocities is approximately Maxwellian, the theory of the electronic bombardment of the kathode filament is criticised. It is supposed that the surplus heating is produced by ionic bombardment which is due to the presence of strongly curved electronic paths. The temperature of the magnetron kathode is measured and it is shown that the second rise in the temperature of the kathode is due to the ionisation of the tungsten vapours. AUTHOR.

***1850. Automatic Stabilisation of Temperature-Limited Currents in Thermionic Valves. R. G. B. Gwyer and E. C. S. Megaw.** *Journ. Sci. Instruments*, 14. *pp.* 76–83, *March*, 1937.—An arrangement is described for reducing changes in the anode current of a saturated diode consequent on variations of kathode supply voltage or emissivity, with particular reference to ultra-short wave oscillators of the kind in which space-charge limitation of the anode current is detrimental. Details of the apparatus required and of its performance are given for a typical case. AUTHORS.

***1851. Laboratory Frequency Standard. G. P. Harnwell and J. B. H. Kuper.** *Rev. Sci. Instruments*, 8. *pp.* 83–86, *March*, 1937.—An inexpensive laboratory frequency standard consisting of a crystal-controlled clock and auxiliaries has been constructed and thoroughly tested. Standardised by the signals from WWV, it permits the measurement of radio- and audio-frequencies to one part in 10^6 or better and also furnishes second ticks for laboratory timing. AUTHORS.

1852. Electromagnetic Waves. G. A. Maggi. *Accad. Lincei, Atti*, 24. *pp.* 246–249, *Nov.* 1, 1936.—The limitations of the conditions of Love at the front of a succession of electromagnetic waves are discussed, and their applications pointed out, especially in connection with Hertzian oscillations. W. A. R.

1853. Polarimetric Method of Investigation of the Upper Layers of the Atmosphere. I. A. Khvostikov and A. N. Sevčenko. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.*, 4. 8. *pp.* 359–363, 1936. *In French.*—The polarisation of the zenith skylight was measured every 20 sec. during twilight. The bulk of the diffused light comes from the limiting (tangential) ray. As the sun sinks below the horizon, the degree of polarisation falls off due to the increasing angle of diffusion; but, in addition, the curves show troughs revealing the presence of ionised air at certain levels. These were roughly at 80, 115, and 150 km. on five sunrise curves (one showed 300 km. as well); and 93 and 135 km. on two taken at sunset. The morning values are higher because the recombination of ions during the night is greater in the lower parts of the layer due to the greater gas density, so that the "centre of ionisation" of the layer is raised. The 150-km. layer evidently disappears completely during the night. With radio-wave reflection, a wave near the critical frequency for reflection from one strongly ionised layer will fail to reveal a lower one having a smaller ion density. However, the lower level (80 and 93 km.) is the more marked and is thought to be the Heaviside layer. Heights measured by wave reflection (averaging 110 km.) are exaggerated, due to the wave penetrating the layer before being completely turned back, and also because the diminished group velocity in the ionised region increases the echo time. Finally a rough estimation, based on the limiting frequency for wave reflection and a layer height of 110 km., indicates an ion concentration of about 1 %. The actnal value is probably higher. R. M.

1854. Physics of the Ionosphere. H. R. Mimno. *Rev. Modern Physics*, 9. *pp.* 1–43, *Jan.*, 1937.—After a brief historical survey of the early radio theories and experiments, the author presents a unified account of researches of the last twelve years. Equations of motion of the electrons; analysis of magneto-ionic double refraction; "fine structure," tidal effects, and local ionospheric clouds; scattering and interaction of radio waves; and eclipse observations, are among the aspects covered. The selected references number 301. R. M.

1855. Problems of Atmospheric Physics. E. V. Appleton. *Roy. Soc. Arts, J.* 85. *pp.* 299–307, *Feb.* 12; 321–330, *Feb.* 19, *and pp.* 338–346, *Feb.* 26, 1937.—The problems dealt with by the author are atmospheric O_3 and electricity in the lower and upper atmospheres. In his treatment of the first he discusses the absorption of solar radiation by O_3 and the measurement of the atmospheric O_3 content. The O_3 distribution round low- and high-pressure centres is indicated by chart and likewise that in the vertical plane. The discussion closes with a consideration of the mode of formation of O_3. The nature of thunderstorm discharges causing electric field variations at considerable distances is dealt with in the second discussion. The investigation of lightning current magnitudes and the nature of lightning by means of the kathode-ray oscillograph shows that these currents are of the order of from 10,000 to 100,000 A, and that the atmospherics produced possess a certain amount of h.f. detail which is probably the cause of interference in radio reception. Also atmospheric interference is regarded as possessing an energy spectrum over a wide range of frequencies so that it becomes impossible to cut out all such interference. Methods of mitigating this effect are indicated. The existence of an ionised layer in the upper atmosphere and its investigation form the subject matter of the third discussion. The layer is shown to be complex and to possess diurnal and seasonal variations. Connection between magnetic activity and ionisation is referred to, while it is shown that the probable cause of " fade-outs " is to be found in bursts of u.v. light from the sun. The problem which arises when dealing with radio and sunspots, which is now awaiting solution, is whether the normal ionisation of the E_1-, F_1 and F_2- regions will follow the sunspot cycle. The series is illustrated by diagrams and photographs. A. E. M. G.

1856. Daylight Variation of Signal Strength. R. C. Colwell and A. W. Friend. *J. of Applied Physics*, 8. *pp.* 141–143, *Feb.*, 1937. A rapidly moving recording galvanometer (Micromax) is used to maintain balance in a Wheatstone bridge. Received radio signals unbalance this bridge, so that an automatic record of voltage signal strength is taken. On daylight signals from nearby stations the signals fluctuate rapidly during each day, and night signals show a relationship dependent upon the barometric pressure. The latter observations agree with those made by Martyn in Australia. As autumn approached in 1936 every station recorded showed an increase of signal strength during the daylight hours. AUTHORS.

1857. Propagation of Radio Signals between Two Distant Points. Irène Mihul and C. Mihul. *Comptes Rendus*, 204. *pp.* 340–343, *Feb.* 1. 1937.—Using the theory for the propagation of short electric waves, based on the hypothesis [see Abstract 4563 (1935)] that the interval of time τ between two successive encounters of an electron with a molecule is the same for all electrons at a definite place in the ionosphere, but varies with the position, it is shown that if λ is the wave-length of the signal and N the ionisation, then the absorption in the ionosphere is caused by the diminution in either of these, and that the signals which usually take two paths, in the evening gradually combine into one. Sometimes, when the ionisation should cause two separate signals, the absorption is so great in the lower part of the ionosphere that the upper signal is lost. H. M. B.

1858. Heights of Reflection of Radio Waves in the Ionosphere. F. H. Murray and J. B. Hoag. *Phys. Rev.* 51. *pp.* 333–341, *March* 1, 1937.—A general method is developed whereby, from the virtual height-frequency curves, it is possible to calculate an upper limit to the height of reflection of a radio wave of a particular frequency in the ionosphere. The various portions of the ionosphere are considered as belonging to one of three groups; first, those in which the electron concentration increases continuously with altitude, the manner of increase being unknown at the start but appearing as a result of the calculations, second, those portions in which the concentration remains essentially constant over an appreciable thickness and, third, those portions for which the concentration is less than the maximum of the region immediately below. It is found that a discontinuity in a virtual height-frequency curve is a necessary but not a sufficient condition for the existence of two distinct layers. When the method is applied to a particular time and place, it is found that, whereas some of the F_2 virtual heights are rising during the morning hours, the true heights are falling. AUTHORS.

See also Abstracts 1577, 1578, 1646, 1776, 1782, 1783, 1809, 1816.

PHOTOELECTRICITY.

1859. Photoelectricity. G. A. Boutry. *Phys. Soc., Reports,* 3. *pp.* 272–289, 1936. Progress review.

1860. Photoelectric Work Functions of the 211 and 310 Planes of Tungsten. C. E. Mendenhall and C. F. DeVoe. *Phys. Rev.* 51. *pp.* 346–349, *March* 1, 1937.—The work functions of a 211 and a 310 plane on one W crystal are determined using Fowler's method. Since the time necessary thoroughly to outgas the crystal would be very great, the photocurrents characteristics of the clean surfaces are determined from data obtained soon after the crystal is flashed at about 2200° C. The work function of the 211 plane is found to be 4·50 V and that for the 310 plane to be 4·35 V. AUTHORS.

See also Abstracts 1528, 1795.

PIEZOELECTRICITY.

1861. Optimum Surface of a Piezoelectric Plate as Function of Frequency. A. de Gramont and D. Beretzki. *Comptes Rendus,* 204. *pp.* 459–462, *Feb.* 15, 1937.—The readiness of quartz plates to oscillate is greatly dependent on the ratio of the square-root of their surface to their thickness. Measurements on a large number of X-cut and AC-cut plates show that the output obtainable is greatest when that ratio has a value of about 35. Square plates of a thickness corresponding to 50 Mc./sec. oscillate readily when their size is reduced to 2 mm. × 2 mm. P. V.

See also Abstract 1798.

THERMIONICS.

1862. Thermionic Emission into Dielectric Liquids. E. B. Baker and H. A. Boltz. *Phys. Rev.* 51. *pp.* 275–282, *Feb.* 15, 1937.—The presence of thermionic emission at ordinary temperatures for kathodes in contact with dielectric liquids is demonstrated. The current voltage relation is shown to obey the law $I = I_0 e^{(e(eFD)^{1/2}/kT)}$, where I is the current, F the field, and D the dielectric constant of the liquid. This is a modification of the Schottky law in vacus. The effects of adsorbed H_2 and O_2, of surface irregularities, and of work function are discussed. The formation of a wax by electron bombardment of the liquid is also reported. AUTHORS.

1863. Activation of Oxide-Kathodes. W. Heinze and S. Wagener. *Zeits. f. techn. Physik,* 17. 12. *pp.* 645–653, 1936.—Fundamentally the rise of emission in the activation of oxide-kathodes can be explained as well by an enlargement of the active surface as by a lessening of the exit work. In the related investigations of Espe and of Detels the question of the change of these magnitudes has been answered by the activation with help of the measured dependence on temperature with different conditions of investigation, upon the basis of Richardson's emission equation. In the present paper an account is given of the investigation of the change of the surfaces of oxide-kathodes, with Ni or Pt as underlying substance, by means of electron-optical pictures and simultaneous measurement of emission. It is shown that already after very short glowing the kathode is fully covered with emission centres. This covering changes but little on farther glowing although the emission changes very strongly. It is further shown that the emission state which is obtained by thermic activation of kathodes with Ni shells is stable and cannot be improved by further formation with current. The change of the surface occurring on different kinds of emission was investigated and it is shown that the surface changes are small compared with the emission changes. The methods of activation employed were (1) activation by pure glowing, (2) activation by emission charge, (3) activation by means of kathodes treated with O. References are given to former work on the subject by different authors, and the paper is followed by short comments upon it by **W. Schottky.** J. J. S.

1864. Influence of Oxygen on Glow Emission Investigated by the Electron Microscope. H. Mahl. *Zeits. f. techn. Physik*, 17. 12. *pp.* 653–656, 1936.—Electron-optical experiments on the effect of O on the glow emission of highly emitting kathodes are described, in which as kathode material W treated with Th, and Mo similarly treated were used. According to Langmuir's experiments and the explanation on Schottky's dipole theory O behaves as a very stable monatomic layer of dipole character upon the glow kathode. As O is electronegative the exit work of the glow kathode will be raised and at the same time its capability of emission increased. By the experiments described it was found that (1) O spreads itself most easily on the Th-covered crystallites of W or Mo which are emitted in the high vacuum, at its strongest. (2) The probability of adsorption of O is specially great at the edges of places of the kathode already covered by O. (3) The adsorption of O follows progressively from the portions of the edges of the places of the kathode free from O. (4) The Th covering after the overlaying of O and its after evaporation does not appear markedly changed. (5) The distribution of intensity in the O-coated kathode, contrary to the O-free kathode, appears to be changed with Th covering. (6) At very small pressures of O the overlaying by O follows, with given Th covering, only under a definite temperature. (7) The adsorbed O appears to compensate the electro-positive dipole deposit of the Th. (8) Through the influence of O on the capability of emission of glow kathodes some obscure results of other observers are explained. J. J. S.

1865. Determination of Oxygen in the Activation of Oxide-Kathodes. H. Isensee. *Zeits. f. phys. Chem.* 35. *Abt.B.* 4. *pp.* 309–316, 1937.—It is generally assumed that the process of activation consists in a thermal or electric reduction of the oxide. To prove this, and to measure the amount of liberated O_2, the latter is burned with H_2, the water vapour frozen out in a liquid-air trap, and the decrease of pressure is measured. The results show that in the process of activation initially about 1/1000 of the current is electrolytic in nature and leads to reduction of the oxide. This fraction decreases during the activation. R. P.

See also Abstract 1849.

THERMOELECTRICITY.

1866. Properties of Metals at Very Low Temperatures. L. Landau and I. Pomerantschusk. *Phys. Zeits. d. Sowjetunion*, 10. 5. *pp.* 649–665, 1936. *In German.*—The effect of electron exchange action upon the electrical resistance of metals is investigated theoretically and an expression in agreement with the Thomson-Onsager relations is derived for the thermo-e.m.f. at low temperatures. L. A. W.